CAYETANO
. OF HAWAII

MICHAEL D. WILSON, CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES

DEPUTY
GILBERT COLOMA-AGARAN

AQUACULTURE DEVELOPMENT PROGRAM
AQUATIC RESOURCES
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STATE PARKS
WATER RESOURCE MANAGEMENT

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION
ENGINEERING BRANCH
P.O. BOX 373
HONOLULU, HAWAII 96809

August 26, 1996

Mr. Russell W. Alger
Director, Hawaii Asset Manager
The Estate of James Campbell
1001 Kamokila Boulevard
Kapolei, Hawaii 96707

Dear Mr. Alger:

Geothermal Resource Mining Lease R-5

We are returning the three (3) executed copies of the "Geothermal License" agreement which allows the Department of Land and Natural Resources to monitor KA-1 geothermal well and SOH-4 well. Please return a copy of the fully executed agreement for our files.

Should you have any questions, please contact Mr. Hiram Young of the Design Section at 587-0260.

Sincerely,

Andrew M. Monden

ANDREW M. MONDEN
Chief Engineer

HY:ek
Enc.
c: Allan Kawada, True Geothermal

JAN 30 1996

TO: Dean Uchida

FROM: Hiram Young

SUBJECT: Campbell Estate Well Monitoring Agreement

Attached for your processing is the final agreement with Campbell Estate to allow us access to their property for a 20-year period for the following:

1. Use True Geothermal's KA1-1 Well as a monitor well

2 Continue monitoring of the Department's SOH-4 monitoring well.

The Department's obligation in return is:

1. Pay the property tax for approximately 200 acres which are the two well sites and access road. This cost is approximately $300 per year.

2. Maintain the 200 acres.

3. Plug the two wells and restoration of the 200 acres at the end of the 20-year period.

ASHFORD & WRISTON
ATTORNEYS AT LAW

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Albert H. Ogawa*
Galen C. K. Leong
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COUNSEL
Dennis A. Krueger
Matthew G. Jewell

OF COUNSEL
Clinton R. Ashford*
*A Law Corporation

January 25, 1996

HAND DELIVER

Mr. Manabu Tagomori
Manager - Chief Engineer
State of Hawaii
Department of Land and Natural Resources
Division of Water and Land Development
1151 Punchbowl Street, Room 227
Honolulu, Hawaii 96813

Re: The Estate of James Campbell - Geothermal License
Kilauea Middle East Rift

Dear Mr. Tagomori:

At the request of Ms. Susan Sublett of the Estate of James Campbell, I enclose three (3) execution originals of the License for the use of two geothermal wells located at the Kilauea Middle East Rift on the Island of Hawaii. I have also enclosed a draft marked to show changes from the last draft we provided you on December 27, 1995.

The enclosed extends the term to twenty (20) years, as requested by the State, requires consent of the Estate for access and use by anyone other than Land Division personnel, and clarifies the State's maintenance obligations.

Your questions and comments regarding the enclosed should be addressed to Ms. Sublett.

Very truly yours,

ASHFORD & WRISTON

By Mary Jo Culbertson
for Jill M. Teutsch

JMT:mjc
Enclosures
cc: Ms. Susan Sublett (w/encl.)

0128212.WP

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BENJAMIN J. CAYETANO
GOVERNOR OF HAWAII

MICHAEL D. WILSON, CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES

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STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
DIVISION OF WATER AND LAND DEVELOPMENT
P.O. BOX 373
HONOLULU, HAWAII 96809

October 25, 1995

Mr. Russell W. Alger
Director, Hawaii Asset Manager
The Estate of James Campbell
1001 Kamokila Boulevard
Kapolei, Hawaii 96707

Dear Mr. Alger:

In response to your September 20, 1995 letter and our previous meeting of September 6, 1995, we are very encouraged to see that the Estate of James Campbell will continue to pursue geothermal development per the Geothermal Resource Mining Lease R-5. Initially, with the announcement of True Geothermal pulling out and subsequent discussions with your staff to monitor the KA1-1 well, we were lead to understand that the Estate was no longer interested in geothermal. Now, however, the Estate has changed it's position to continue with geothermal development. This change is reflected in the August 30, 1995 "final draft" of the monitoring agreement for KA1-1 well where the Estate will retain the development rights. This right to retain the development rights is vested by the Estate's continued ownership of KA1-1 well.

According to our records, the KA1-1 well is capable of producing a geothermal resource which can be used for production. As such, the conditions of the mining lease which required you to have completed a well capable of producing geothermal resources has been satisfied. The well is a very valuable asset. It shows that geothermal resources can be developed within the 9,014 acres of the geothermal mining lease. For the Department, the well has significant scientific value as we continue to assess the geothermal resource in the Kilauea East Rift Zone. The data gained from monitoring will help enhance the Estate's development of geothermal.

As we review the "final draft" agreement of August 30, 1995, there is a mutual benefit to both the Estate and the Department for continued monitoring of KA1-1 well, we suggest the following change:

1. The Department be allowed to monitor KA1-1 well until such time that the Estate is ready to put the well into production of geothermal resources.

2. The data collected by the Department will be shared with the Estate.

3. The Department will be responsible for maintenance of the well site and access road leading to the well.

4. The terms of payment the Department will incur to monitor the well shall be gratis or at a maximum, prorated according to the land area it is using for monitoring.

Please note the final approval of the above terms is subject to approval by the Land Board. In summary, the continuation of geothermal development is mutually beneficial to the Estate, the Department and the Big Island residents. Should you have any questions, please do not hesitate to call me at 587-0230.

Sincerely,

Manabu Tagomori

HY:lk

THE ESTATE OF JAMES CAMPBELL

September 20, 1995

95 SEP 21 A9:28

Mr. Manabu Tagomori
Manager and Chief Engineer
Division of Water and Land
Development
Department of Land and
Natural Resources
State of Hawaii
P. O. Box 373
Honolulu, Hawaii 96809

Re: Lease to State for Geothermal Monitoring Wells

Dear Mr. Tagomori:

Thank you for your letter of September 15, 1995 stating the procedure for sharing the real property tax and geothermal mining lease costs on the subject Puna lands.

The County of Hawaii real property assessed value of the 27,785.89 acres for the 1995-96 tax year was $4,471,300 and the resulting property taxes are $44,713. The True well cost $16 million total per Allan Kawada and the University well cost $1.5 million for a total of $17.5 million. Based on these values and assuming the State lease area totals 200 acres, the first year cost sharing would be as follows:

	Ratios			Cost Apportionment	
Item	State	Campbell	Total	State	Campbell
Land Value	200 27,785 = .0072	27,585 27,785 = .9928	$4,471,300	$ 32,193	$4,439,107
Well Value	100%	0%	17,500,000	17,500,000	---
TOTAL			$21,978,300	$17,532,193	$4,439,107
	Sharing of taxes and mining lease			79.8%	20.2%

For the lease term, the State will be responsible for 79.8% of the real property tax and 79.8% of the State mining lease cost of $9,014 per year. For the first year this would

1001 Kamokila Boulevard, Kapolei, Hawaii 96707 Phone (808) 674-6674 Facsimile (808) 674-3111

compute to $35,681 for property tax and $7,193 for the mining lease yielding a total of $42,874.

Please let me know if you have any questions. Also, do you prefer structuring the agreement to call for an annual lease rent payment to the Estate or should it be a waiver of Estate payment of 79.8% of the real property tax and mining lease rent each year? Either way is acceptable to us.

Sincerely,

Russell W Alger
Director, Hawaii Asset Management

blk:01050300\K10054

RICHARD PALLANGO
81 LUDLAM DR.
MIAMI SPRINGS, FL. 33166

OCT. 02, 1995

KEITH AHUE,
DIRECTOR OF THE DEPARTMENT
OF LAND AND NATURAL RESOURCES
STATE OF HAWAII,
P.O. BOX 621
HONOLULU, HI. 96809

DEAR MR. AHUE:

I AM ENCOURAGED TO HEAR THAT TRUE GEOTHERMAL ENERGY COMPANY HAS FORMALLY PULLED OUT OF THE WAO KELE O PUNA RAIN FOREST. I URGE YOU TO RECOGNIZE THAT THIS FOREST HAS MORE VALUE AS A NATIVE HAWAIIAN RAIN FOREST FOR THE PROTECTION OF CULTURAL AND BIOLOGICAL DIVERSITY THAN IT DOES AS A FUTURE GEOTHERMAL EXPLORATION SITE.

THE STATE GOVERNMENT AND CAMPBELL ESTATE WILL ASSUME GREAT LIABILITY FOR THE CONTINUED USE OF TRUE'S WELL AND ACCESS ROAD FOR DEVELOPMENT AND/OR MONITORING PURPOSES. THE EYES OF THE WORLD CONTINUE TO WATCH IN THE HOPES THAT YOU WILL TAKE RESPONSIBILITY TO REPAIR THE GEOTHERMAL DAMAGE, RESPECT NATIVE HAWAIIAN RIGHTS, AND PERMANENTLY PROTECT WAO KELE O PUNA.

SINCERELY

RICHARD J. PALLANGO

BENJAMIN J. CAYETANO
GOVERNOR OF HAWAII

MICHAEL D. WILSON, CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES

DEPUTY
GILBERT COLOMA-AGARAN

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STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
DIVISION OF WATER AND LAND DEVELOPMENT
P. O. BOX 373
HONOLULU, HAWAII 96809

September 15, 1995

Mr. Russell W. Alger
Director, Hawaii Asset Manager
The Estate of James Campbell
1001 Kamokila Boulevard
Kapolei, Hawaii 96707

Dear Mr. Alger:

As a follow-up of our September 6, 1995 meeting with you and Ms. Susan Sublett of your staff, we would like to summarize our understanding of the terms which the Department will be allowed to access and monitor True's KA1-1 and SOH-4 wells. Specifically, the terms of payment for the property tax and geothermal mining lease will be handled in the following manner:

1. The property tax which the Department will be responsible for paying will be proportioned to the actual land area used for the monitoring of both the KA1-1 and SOH-4 wells vs. the entire parcel of 27,785.89 acres; and

2. Similarly, the geothermal mining lease rent shall also be proportioned to the actual land area used for monitoring the two wells vs. the geothermal mining lease area of 9,014 acres.

In both cases, the value of the two wells shall be included in the calculation of the percentage to be used in prorating the property tax and geothermal mining lease.

Should you have any questions, please do not hesitate to call me at 587-0230.

Sincerely,

MANABU TAGOMORI
Manager-Chief Engineer

HY:ek
Attachment

ASHFORD & WRISTON
ATTORNEYS AT LAW

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OF COUNSEL
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*A Law Corporation

August 30, 1995

HAND DELIVER

Mr. Hiram Young
State of Hawaii
Department of Land and Natural Resources
Division of Water & Land Development
1151 Punchbowl Street, Room 227
Honolulu, Hawaii 96813

Re: Geothermal License

Dear Mr. Young:

At Susan Sublett's request, I enclose three (3) execution originals of the License between the Trustees under the Will and of the Estate of James Campbell, Deceased and the Department of Land and Natural Resources for monitoring a geothermal well located at Puna, Island of Hawaii. The License has been revised in accordance with your letter to Ms. Sublett dated August 29, 1995.

Very truly yours,

ASHFORD & WRISTON

By
Jill M. Teutsch

JMT:mjc

Enclosures

cc: Susan Sublett (w/encl.)

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BENJAMIN J. CAYETANO
GOVERNOR OF HAWAII

KEITH W. AHUE, CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES

DEPUTIES
JOHN P. KEPPELER, II

AQUACULTURE DEVELOPMENT PROGRAM
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STATE PARKS
WATER AND LAND DEVELOPMENT

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
P. O. BOX 621
HONOLULU, HAWAII 96809

REF:WL-EK

December 28, 1994

Mr. Russell W. Alger
Director, Hawaii Asset Manger
The Estate of James Campbell
1001 Kamokila Boulevard
Kapolei, Hawaii 96707

Dear Mr. Alger:

We request that you rescind the December 16, 1994 letter to True Geothermal to allow the State and Campbell Estate to work towards consummating an agreement for the use of geothermal KA1-1 as a monitoring well.

With reference to the November 1, 1994 meeting between our staffs to discuss a draft agreement prepared by Campbell Estate covering the KA1-1 well site and access road, we agree to expand the area for leasing the entire 27,785.891 acres. As such the new agreement should include the following items:

1. Lease the entire 27,785.891 acres for a time period to coincide with the existing geothermal mining lease R-5 at gratis fee.

2. The State assume property tax and mining lease fee.

3. The State agrees to rescind or renegotiate this agreement if and when Campbell desires to pursue geothermal development of the site.

We believe the above proposal will be mutually beneficial as the State will assume all monitoring risks. The Estate may plan to derive revenues from the property if and when geothermal developer produces electricity.

We would appreciate your preparing a new draft to include the above provisions as soon as possible.

Very truly yours,

Keith W. Ahue

KEITH W. AHUE
Chairperson

c: True Geothermal Energy company and Mid Pacific Geothermal Corp.

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
Division of Water and Land Development
Honolulu, Hawaii

March 24, 1994

Board of Land and Natural Resources
State of Hawaii
Honolulu, Hawaii

Use of Well KA1-1 for Geothermal Resource Monitoring and Assessment at Kilauea Middle East Rift Zone, Hawaii

Background

Under CDUA Decision and Order No. HA-12/20/85-1830 dated April 11, 1986, Campbell Estate and True/Mid-Pacific Geothermal Venture (True) received permission to conduct geothermal exploratory activities to determine the existence of a geothermal resource capable of providing up to 25 megawatts of electrical power within the Kilauea Middle East Rift Geothermal Resource Subzone. Campbell Estate, which has an operating agreement with True, was issued a Geothermal Mining Lease R-5 dated 23 July 1987. True has developed well KA1-1 but has decided to cease operations and has no further plans to utilize the well. True's decision not to utilize well KA1-1 presents the State the opportunity to take over the well for geothermal resource monitoring and assessment purposes. The Division of Water and Land Development and Department's Geothermal Technical Advisory Committee (GeoTAC) recommends that the State of Hawaii monitor as many deep geothermal wells as possible in order to best manage the geothermal resources of the Kilauea East Rift zone (KERZ).

Staff Analysis

The Division of Water and Land Development is responsible for developing and monitoring a model of the geothermal reservoir as part of its regulatory role in managing the geothermal resources of the Kilauea East Rift Zone. The Division has determined, in conjunction with its GeoTAC scientific advisors that it is important to gather deep reservoir data to determine the availability of geothermal resources and best management practices through a network of monitoring wells. Efforts made to date for monitor wells include the drilling of three scientific observation holes, GeoTAC scientists obtaining permission to monitor various wells on the Puna Geothermal Venture (PGV) site, and GeoTAC exploring the possibility of the State monitoring other geothermal wells that are not being utilized.

Well KA1-1 presents an excellent opportunity to gain an additional data point which would be valuable for monitoring the geothermal reservoir that includes the resource tapped by PGV's 25 megawatt electrical generating facility. In addition to temperature and pressure, other characteristics such as steam and water chemistry, meteorological data, and seismicity can be monitored at this site. KA1-1 would provide a baseline for these key parameters that are unaffected by geothermal production. Any data that might indicate changes in fluid chemistry, seismicity, magma movement, or deep hydrology (reservoir pressure and temperature) could, with a high degree of confidence, be presumed to be natural in origin. It would therefore yield baseline information and would indicate whether any changes on PGV's site are regional or associated with production activities. Monitoring KA1-1 would also extend many already promising studies to further refine models of rift seismicity and reservoir dynamics, thus improving the Division's ability to effectively manage geothermal resources.

ITEM D-2

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
Division of Water and Land Development
Honolulu, Hawaii

March 24, 1994

Board of Land and Natural Resources
State of Hawaii
Honolulu, Hawaii

Transfer of Scientific Observation Holes for Geothermal Resource Monitoring and Assessments at Kilauea East Rift Zone, Hawaii

Background

Between 1989 and 1991, the Department of Business, Economic Development & Tourism (DEBDT) made funds available to Hawaii Natural Energy Institute to drill three scientific observation holes (SOH). Three wells were drilled under Hawaii County Geothermal Resource Permit (GRP) of August 8, 1989. The purpose of these scientific observations holes was to assess subsurface geological conditions, ground water level and composition, temperature, and drilling conditions, inventory possible mineral and geothermal resources and develop the eruptive history of the island to the depth drilled. Since the completion of drilling, the SOH's have been instrumented to provide data relating to reservoir productivity. Funding from DBEDT is no longer available for continued monitoring. Monitoring should continue, however, so that in combination with data from existing geothermal wells, a current picture of reservoir conditions and productivity can be maintained.

Staff Analysis

The Division of Water and Land Development is responsible for developing and monitoring a model of the geothermal reservoir as part its regulatory role in managing the geothermal resources of the Kilauea East Rift Zone. The Division has determined, in conjunction with its Geothermal Technical Advisory Committee (GeoTAC) scientific advisors that it is important to gather deep reservoir data to determine the availability of geothermal resources and best management practices through a network of monitoring wells. Efforts made to date for monitor wells include the drilling of thee scientific observation holes, GeoTAC scientists gaining permission to monitor various wells on the Puna Geothermal Venture (PGV) site, and GeoTAC exploring the possibility of the State monitoring other geothermal wells that are not being utilized.

The SOH wells present an excellent opportunity to gain additional data points which would be valuable for monitoring the geothermal reservoir that includes the resource tapped by PGV's 25 megawatt electrical generating facility. In addition to temperature and pressure, other characteristics such as steams and water chemistry, meteorological data, and seismicity can be monitored at this site. The three SOH observation holes would provide additional baselines for these key parameters that are unaffected by geothermal production. Any data that might indicate changes in fluid chemistry, seismicity, magma movement, or deep hydrology (reservoir pressure and temperature) could, with a high degree of confidence, be presumed to be natural in origin. It would therefore yield baseline information and would indicate whether any changes on PGV's site are regional or associates with production activities. Continued monitoring of the SOH observation holes would also extend many

ITEM D-1

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
Division of Water and Land Development
Honolulu, Hawaii

March 24, 1994

Board of Land and Natural Resources
State of Hawaii
Honolulu, Hawaii

Use of Well KA1-1 for Geothermal Resource Monitoring and Assessment at Kilauea Middle East Rift Zone, Hawaii

Background

Under CDUA Decision and Order No. HA-12/20/85-1830 dated April 11, 1986, Campbell Estate and True/Mid-Pacific Geothermal Venture (True) received permission to conduct geothermal exploratory activities to determine the existence of a geothermal resource capable of providing up to 25 megawatts of electrical power within the Kilauea Middle East Rift Geothermal Resource Subzone. Campbell Estate, which has an operating agreement with True, was issued a Geothermal Mining Lease R-5 dated 23 July 1987. True has developed well KA1-1 but has decided to cease operations and has no further plans to utilize the well. True's decision not to utilize well KA1-1 presents the State the opportunity to take over the well for geothermal resource monitoring and assessment purposes. The Division of Water and Land Development and Department's Geothermal Technical Advisory Committee (GeoTAC) recommends that the State of Hawaii monitor as many deep geothermal wells as possible in order to best manage the geothermal resources of the Kilauea East Rift zone (KERZ).

Staff Analysis

The Division of Water and Land Development is responsible for developing and monitoring a model of the geothermal reservoir as part of its regulatory role in managing the geothermal resources of the Kilauea East Rift Zone. The Division has determined, in conjunction with its GeoTAC scientific advisors that it is important to gather deep reservoir data to determine the availability of geothermal resources and best management practices through a network of monitoring wells. Efforts made to date for monitor wells include the drilling of three scientific observation holes, GeoTAC scientists obtaining permission to monitor various wells on the Puna Geothermal Venture (PGV) site, and GeoTAC exploring the possibility of the State monitoring other geothermal wells that are not being utilized.

Well KA1-1 presents an excellent opportunity to gain an additional data point which would be valuable for monitoring the geothermal reservoir that includes the resource tapped by PGV's 25 megawatt electrical generating facility. In addition to temperature and pressure, other characteristics such as steam and water chemistry, meteorological data, and seismicity can be monitored at this site. KA1-1 would provide a baseline for these key parameters that are unaffected by geothermal production. Any data that might indicate changes in fluid chemistry, seismicity, magma movement, or deep hydrology (reservoir pressure and temperature) could, with a high degree of confidence, be presumed to be natural in origin. It would therefore yield baseline information and would indicate whether any changes on PGV's site are regional or associated with production activities. Monitoring KA1-1 would also extend many already promising studies to further refine models of rift seismicity and reservoir dynamics, thus improving the Division's ability to effectively manage geothermal resources.

...oved by the Board of
...d & Natural Resources
...the meeting held on
MAR 24 1994

ITEM D-2

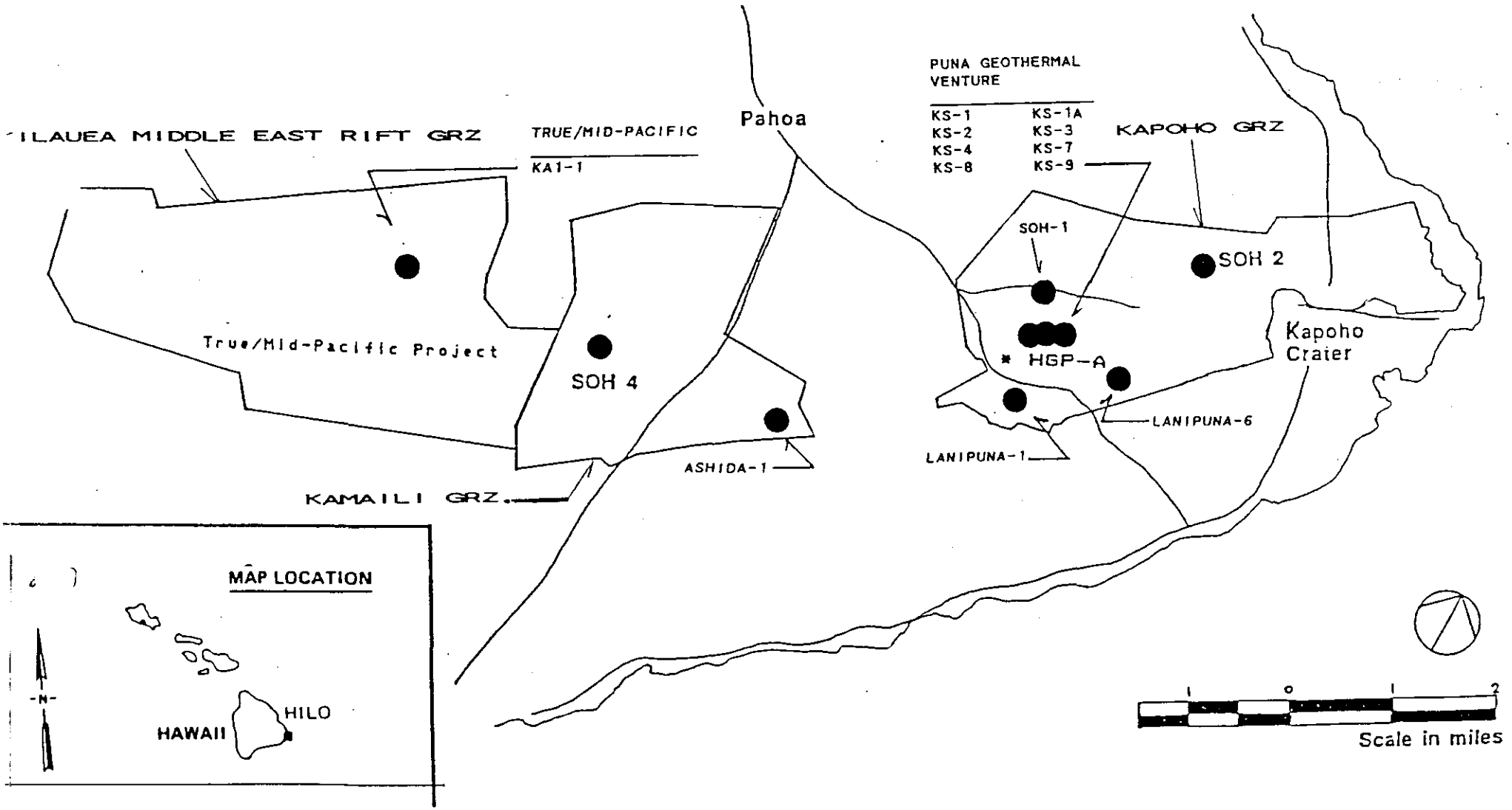

Figure 1. GEOTHERMAL WELLS IN THE KILAUEA EAST RIFT ZONE

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
Division of Water and Land Development
Honolulu, Hawaii

March 24, 1994

Board of Land and Natural Resources
State of Hawaii
Honolulu, Hawaii

Transfer of Scientific Observation Holes for Geothermal Resource Monitoring and Assessments at Kilauea East Rift Zone, Hawaii

Background

Between 1989 and 1991, the Department of Business, Economic Development & Tourism (DBEDT) made funds available to Hawaii Natural Energy Institute to drill three scientific observation holes (SOH). Three wells were drilled under Hawaii County Geothermal Resource Permit (GRP) of August 8, 1989. The purpose of these scientific observations holes was to assess subsurface geological conditions, ground water level and composition, temperature, and drilling conditions, inventory possible mineral and geothermal resources and develop the eruptive history of the island to the depth drilled. Since the completion of drilling, the SOH's have been instrumented to provide data relating to reservoir productivity. Funding from DBEDT is no longer available for continued monitoring. Monitoring should continue, however, so that in combination with data from existing geothermal wells, a current picture of reservoir conditions and productivity can be maintained.

Staff Analysis

The Division of Water and Land Development is responsible for developing and monitoring a model of the geothermal reservoir as part its regulatory role in managing the geothermal resources of the Kilauea East Rift Zone. The Division has determined, in conjunction with its Geothermal Technical Advisory Committee (GeoTAC) scientific advisors that it is important to gather deep reservoir data to determine the availability of geothermal resources and best management practices through a network of monitoring wells. Efforts made to date for monitor wells include the drilling of thee scientific observation holes, GeoTAC scientists gaining permission to monitor various wells on the Puna Geothermal Venture (PGV) site, and GeoTAC exploring the possibility of the State monitoring other geothermal wells that are not being utilized.

The SOH wells present an excellent opportunity to gain additional data points which would be valuable for monitoring the geothermal reservoir that includes the resource tapped by PGV's 25 megawatt electrical generating facility. In addition to temperature and pressure, other characteristics such as steams and water chemistry, meteorological data, and seismicity can be monitored at this site. The three SOH observation holes would provide additional baselines for these key parameters that are unaffected by geothermal production. Any data that might indicate changes in fluid chemistry, seismicity, magma movement, or deep hydrology (reservoir pressure and temperature) could, with a high degree of confidence, be presumed to be natural in origin. It would therefore yield baseline information and would indicate whether any changes on PGV's site are regional or associates with production activities. Continued monitoring of the SOH observation holes would also extend many

already promising studies to further refine models of rift seismicity and reservoir dynamics, thus improving the Division's ability to effectively manage geothermal resources.

Comparatively, it would cost the State about $4 million to construct monitor wells at each SOH well site.

The alternative to the State's taking over the SOH wells for monitoring purposes would be for DBEDT to plug and abandon the wells, per State regulations. However, once a well is plugged, it is lost forever for monitoring purposes. This is the case with other geothermal wells drilled and abandoned in the past.

Monitoring the SOH holes will be performed by the Department cooperative with the University of Hawaii using existing equipment and personnel. Therefore, no additional resources would be required.

Summary and Conclusions

It is in the State's interest to take over the SOH wells for geothermal reservoir monitoring in order to better understand the geothermal reservoir.

RECOMMENDATION

That the Board authorize the Department to enter into a Memorandum of Agreement with DBEDT and the Hawaii Natural Energy Institute of the University of Hawaii to transfer the SOH wells for monitoring purposes and authorize the Chairperson to sign all documents pertaining thereto.

Respectfully submitted,

MANABU TAGOMORI
Manager-Chief Engineer

APPROVED FOR SUBMITTAL:

KEITH W. AHUE, Chairperson

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
Division of Water and Land Development
Honolulu, Hawaii

March 24, 1994

Board of Land and Natural Resources
State of Hawaii
Honolulu, Hawaii

Use of Well KA1-1 for Geothermal Resource Monitoring and Assessment at Kilauea Middle East Rift Zone, Hawaii

Background

Under CDUA Decision and Order No. HA-12/20/85-1830 dated April 11, 1986, Campbell Estate and True/Mid-Pacific Geothermal Venture (True) received permission to conduct geothermal exploratory activities to determine the existence of a geothermal resource capable of providing up to 25 megawatts of electrical power within the Kilauea Middle East Rift Geothermal Resource Subzone. Campbell Estate, which has an operating agreement with True, was issued a Geothermal Mining Lease R-5 dated 23 July 1987. True has developed well KA1-1 but has decided to cease operations and has no further plans to utilize the well. True's decision not to utilize well KA1-1 presents the State the opportunity to take over the well for geothermal resource monitoring and assessment purposes. The Division of Water and Land Development and Department's Geothermal Technical Advisory Committee (GeoTAC) recommends that the State of Hawaii monitor as many deep geothermal wells as possible in order to best manage the geothermal resources of the Kilauea East Rift zone (KERZ).

Staff Analysis

The Division of Water and Land Development is responsible for developing and monitoring a model of the geothermal reservoir as part of its regulatory role in managing the geothermal resources of the Kilauea East Rift Zone. The Division has determined, in conjunction with its GeoTAC scientific advisors that it is important to gather deep reservoir data to determine the availability of geothermal resources and best management practices through a network of monitoring wells. Efforts made to date for monitor wells include the drilling of three scientific observation holes, GeoTAC scientists obtaining permission to monitor various wells on the Puna Geothermal Venture (PGV) site, and GeoTAC exploring the possibility of the State monitoring other geothermal wells that are not being utilized.

Well KA1-1 presents an excellent opportunity to gain an additional data point which would be valuable for monitoring the geothermal reservoir that includes the resource tapped by PGV's 25 megawatt electrical generating facility. In addition to temperature and pressure, other characteristics such as steam and water chemistry, meteorological data, and seismicity can be monitored at this site. KA1-1 would provide a baseline for these key parameters that are unaffected by geothermal production. Any data that might indicate changes in fluid chemistry, seismicity, magma movement, or deep hydrology (reservoir pressure and temperature) could, with a high degree of confidence, be presumed to be natural in origin. It would therefore yield baseline information and would indicate whether any changes on PGV's site are regional or associated with production activities. Monitoring KA1-1 would also extend many already promising studies to further refine models of rift seismicity and reservoir dynamics, thus improving the Division's ability to effectively manage geothermal resources.

ITEM D-2

If geothermal production activity should occur within the Kilauea Middle East Rift Geothermal Resource Subzone, KA1-1 well would provide pre-development data which would be invaluable for assessing and managing the resource. Comparatively, it would cost the State about $2 million to construct a monitor well at this site.

The alternative to the State's taking over KA1-1 well for monitoring purposes would be for True to plug and abandon the well, per State regulations. However, once a well is plugged, it is lost forever for monitoring purposes. This was the case with other geothermal wells previously drilled and abandoned in the past. Monitoring KA1-1 well will be performed by the Department cooperatively with the University of Hawaii using existing equipment and personnel. Therefore, no additional resources would be required.

Summary and Conclusions

It is in the State's interest to use KA1-1 well from True for geothermal reservoir monitoring in order to better understand the KERZ geothermal reservoir.

RECOMMENDATION

That the Board authorize the Department to enter into a Memorandum of Agreement with Campbell Estate to use KA1-1 well for monitoring purposes and authorize the Chairperson to sign all documents pertaining there subject to Campbell Estate's conformation.

Respectfully submitted,

MANABU TAGOMORI
Manager-Chief Engineer

APPROVED FOR SUBMITTAL

KEITH W. AHUE, Chairperson

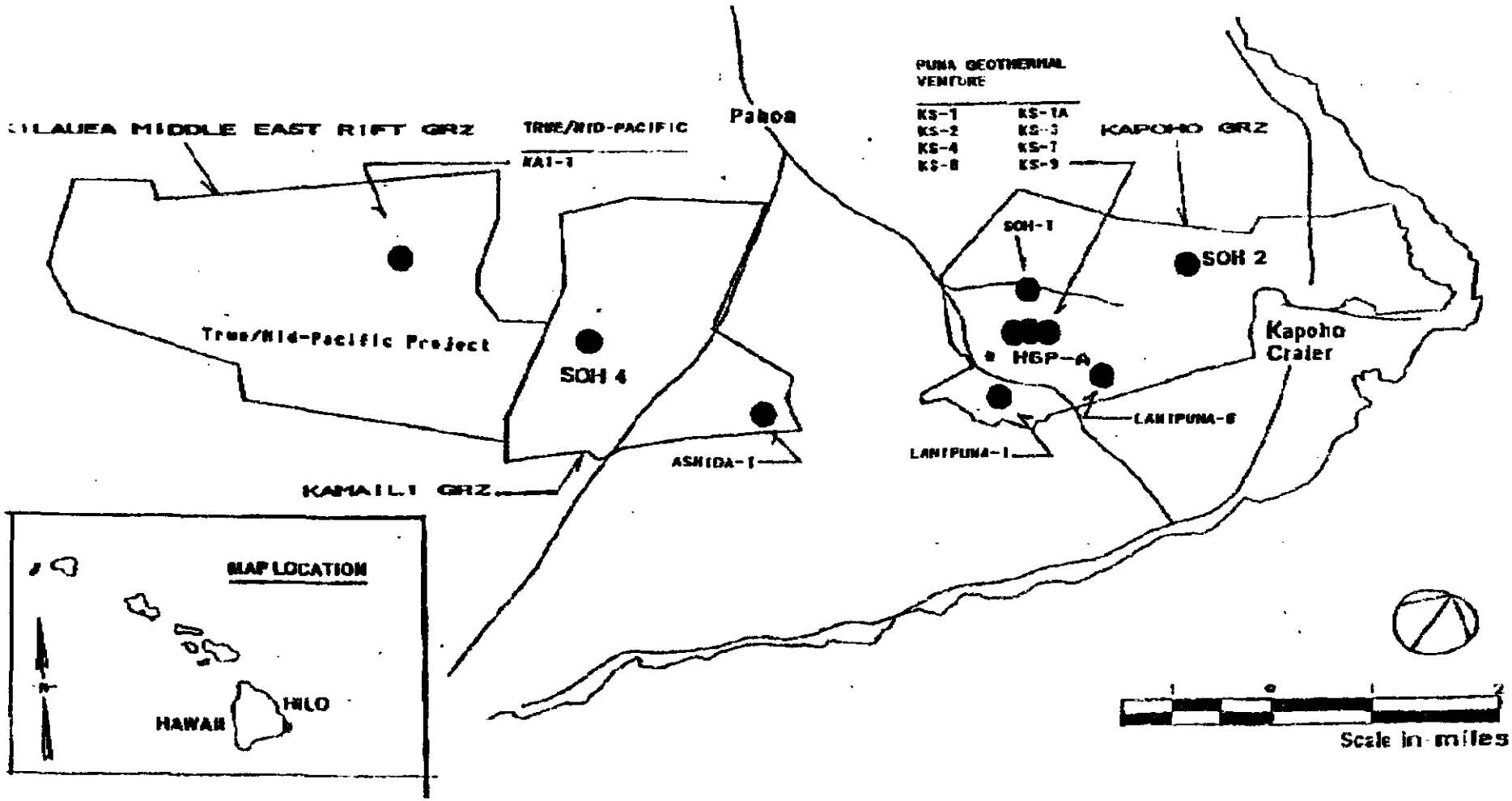

Figure 1. GEOTHERMAL WELLS IN THE KILAUEA EAST RIFT ZONE

JOHN WAIHI
Govern
MUFI HANNEMAN
Direct
RICK EGGE
Deputy Direct
JEANNE K. SCHUL
Deputy Direct
TAKESHI YOSHIHAR
Deputy Direct

DEPARTMENT OF BUSINESS, ECONOMIC DEVELOPMENT & TOURISM

Central Pacific Plaza, 220 South King Street, 11th Floor, Honolulu, Hawaii
Mailing Address: P.O. Box 2359, Honolulu, Hawaii 96804 Telephone: (808) 586-2406 Fax: (808) 586-2377

94:539

June 29, 1994

TO: The Honorable Keith Ahue, Chairman
Board of Land and Natural Resources

FROM: Mufi Hannemann MH

SUBJECT: Memorandum of Agreement for the Transfer of the Scientific Observation Holes

The Memorandum of Agreement (MOA) for the transfer of the Scientific Observation Holes (SOHs) from the University of Hawaii's Hawaii Natural Energy Institute (HNEI) to the Department of Land and Natural Resources (DLNR) has been executed by all parties and a copy is enclosed for your files.

In fulfillment of the MOA terms and conditions, HNEI has completed the required training of DLNR staff in the use and maintenance of the SOH monitoring equipment and has initiated the transfer of all SOH-related equipment to DLNR. We are pleased that the transfer will allow the continued use of the SOHs for your department's regulatory and resource management activities.

With regard to your Division of Water and Land Development's request for $70,000 to monitor the SOHs and the True/Mid-Pacific well (KA1-1), we are unable to provide any funding at this time. However, we remain committed to assisting your department in securing future legislative appropriations in support of your geothermal monitoring program.

Thank you for your cooperation and assistance in this matter. Should you have any questions, please contact Dr. Takeshi Yoshihara, Deputy Director, at 586-2365.

Enclosure

cc: Manabu Tagomori

MEMORANDUM OF AGREEMENT

Relating to the Transfer of the Scientific Observation Holes

This Agreement, effective the 15th day of June, 1994 is entered into by and between the Department of Land & Natural Resources (DLNR), the Department of Business, Economic Development & Tourism (DBEDT), and the Hawaii Natural Energy Institute of the University of Hawaii (HNEI).

BACKGROUND

Three Scientific Observation Holes (SOH) were drilled by HNEI to advance understanding of the geothermal resource along the Kilauea East Rift Zone (KERZ), Island of Hawaii. Funding for the SOH Program was provided under State of Hawaii Contracts No. 24271 and No. 25751, both of which expired on 7/1/93. Continued support of state regulatory and resource management functions has been provided through data collection and downhole pressure monitoring of the SOHs conducted under State of Hawaii Contract No. 33272. Funding for this monitoring activity will terminate on June 30, 1994.

The Geothermal Well Drilling Permits issued by DLNR for SOH-1, -2 and -4, dated August 31, 1989 require that the SOHs be "plugged and abandoned in accordance with Administrative Rules, Chapter 13-183" when the SOHs are no longer used for monitoring purposes. In addition, the Geothermal Resource Permit (GRP 89-1) issued by the Hawaii County Planning Commission (and DLNR Well Drilling Permits) requires that the SOH sites be restored as near as possible to their original condition after operations are completed.

DLNR has the responsibility and authority for regulation of geothermal resource subzones and management of the geothermal resource. DLNR's responsibilities include, but are not limited to, regulation of well construction and operation to prevent waste, conserve resources, and for safety and protection of the environment. DLNR also monitors and regulates operations relative to geothermal exploration and development, modification of geothermal wells, well abandonment, and associated data collection activities.

The statutory function and responsibility of DBEDT, through its Director as the Energy Resources Coordinator, is to plan and coordinate energy programs within the state. Towards that end, DBEDT formulates plans and programs for the optimum and safe utilization of Hawaii's geothermal energy resources which include developing and recommending programs to facilitate research, assessment, and resource management activities.

HNEI serves as the technology research and development arm of the University of Hawaii's School of Ocean and Earth Science and Technology (SOEST). In implementing the SOH Program, HNEI administered permit acquisition, drilling operations, data collection, and monitoring activities related to assessment of the geothermal potential of the KERZ.

PURPOSE

The purpose of this Memorandum of Agreement (MOA) is to identify and set forth the terms and conditions for the transfer and assignment of responsibility for the Scientific Observation Holes from HNEI to DLNR. The continued monitoring of the SOHs is necessary to DLNR's regulatory and resource management responsibilities. Execution of this MOA will provide for the orderly transfer of the SOHs and the continuance of all monitoring operations and maintenance responsibilities for the SOHs and related equipment to DLNR.

TERMS AND CONDITIONS

1. DLNR assumes responsibility for management, monitoring, and long-term maintenance of the SOHs. DLNR also assumes responsibility for downhole pressure monitoring equipment, including any retrieval, cleaning, and/or storage of such equipment upon satisfaction of all equipment transfer requirements and receipt of applicable documentation.

2. DLNR, in its discretion, may continue the SOH downhole pressure monitoring program and/or initiate any other monitoring program utilizing the SOHs.

3. DLNR assumes responsibility for any required permits or approvals, including compliance with any landowner notification/agreements required for continued access, monitoring, maintenance, and final disposition of the SOHs, including proper plugging/abandonment of the SOHs and site restoration, if required.

4. Funding of the SOEST Monitoring and Testing Project by DBEDT will terminate effective June 30, 1994. Continued funding for SOH monitoring operations after June 30, 1994, shall be the responsibility of DLNR, including the proper plugging and abandonment of the SOHs and any site restoration, if required.

5. The Right of Entry License effective January 1, 1991 by and among the Trustees Under the Will and of the Estate of James Campbell, Deceased, and True/Mid-Pacific Geothermal Venture, and the University of Hawaii, for the Hawaii Natural Energy Institute; and the Revocable Right of Entry Agreement dated March 19, 1990 between Kapoho Land Partnership, A Limited Partnership, and Puna Geothermal Venture, and the University of Hawaii, for its Hawaii Natural Energy Institute shall be canceled.

   DLNR separately shall enter into agreements for rights of entry to the SOH sites with the Trustees Under the Will and of the Estate of James Campbell, Deceased; and with Kapoho Land Partnership, A Limited Partnership, and Puna Geothermal Venture.

6. HNEI shall coordinate and provide proper training of DLNR staff in the use and maintenance of the SOH monitoring equipment.

7. All permit obligations/conditions, explicit or otherwise, are hereby assumed by DLNR.

In witness whereof, the parties hereto have executed this Agreement effective as of the date first above written.

DEPARTMENT OF LAND AND NATURAL RESOURCES

By _____
Its Chairperson

DEPARTMENT OF BUSINESS, ECONOMIC DEVELOPMENT & TOURISM

By _____
Its Director

HAWAII NATURAL ENERGY INSTITUTE OF THE UNIVERSITY OF HAWAII

By _____
Its Director

APPROVED AS TO FORM:

_____
Deputy Attorney General
State of Hawaii

JOHN WAIHEE
GOVERNOR OF HAWAII

KEITH W. AHUE, CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES

DEPUTIES

JOHN P. KEPPELER, II
DONA L. HANAIKE

AQUACULTURE DEVELOPMENT PROGRAM
AQUATIC RESOURCES
CONSERVATION AND ENVIRONMENTAL AFFAIRS
CONSERVATION AND RESOURCES ENFORCEMENT
CONVEYANCES
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION
LAND MANAGEMENT
STATE PARKS
WATER AND LAND DEVELOPMENT

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
DIVISION OF WATER AND LAND DEVELOPMENT
P. O. BOX 373
HONOLULU, HAWAII 96809

JUN - 7 1994

TO: Maurice H. Kaya
Energy Program Administrator
Department of Business, Economic Development & Tourism

FROM: Manabu Tagomori, Manager-Chief Engineer
Division of Water and Land Development

SUBJECT: **SCIENTIFIC OBSERVATION HOLES (SOHs)**

Enclosed for your review and processing is the signed Memorandum of Agreement (MOA) for the transfer of the Scientific Observation Holes (SOHs). Please send us a copy of the fully executed document for our files.

Also attached for your review and approval is a breakdown of the funds we will require for the next fiscal year to monitor the three SOHs and True's KA1-1 well. We request that $70,000 of the funds in the SOEST contract be reserved for this monitoring work until funds can be secured in the forthcoming biennium.

Should you have any questions regarding the MOA or the budget request, please have your staff contact Gordon Akita at extension 70227.

HY:ek
Enc.

MEMORANDUM OF AGREEMENT

Relating to the Transfer of the Scientific Observation Holes

This Agreement, effective the _____ day of _____, 1994 is entered into by and between the Department of Land & Natural Resources (DLNR), the Department of Business, Economic Development & Tourism (DBEDT), and the Hawaii Natural Energy Institute of the University of Hawaii (HNEI).

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The statutory function and responsibility of DBEDT, through its Director as the Energy Resources Coordinator, is to plan and coordinate energy programs within the state. Towards that end, DBEDT formulates plans and programs for the optimum and safe utilization of Hawaii's geothermal energy resources which include developing and recommending programs to facilitate research, assessment, and resource management activities.

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PURPOSE

The purpose of this Memorandum of Agreement (MOA) is to identify and set forth the terms and conditions for the transfer and assignment of responsibility for the Scientific Observation Holes from HNEI to DLNR. The continued monitoring of the SOHs is necessary to DLNR's regulatory and resource management responsibilities. Execution of this MOA will provide for the orderly transfer of the SOHs and the continuance of all monitoring operations and maintenance responsibilities for the SOHs and related equipment to DLNR.

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2. DLNR, in its discretion, may continue the SOH downhole pressure monitoring program and/or initiate any other monitoring program utilizing the SOHs.

3. DLNR assumes responsibility for any required permits or approvals, including compliance with any landowner notification/agreements required for continued access, monitoring, maintenance, and final disposition of the SOHs, including proper plugging/abandonment of the SOHs and site restoration, if required.

4. Funding of the SOEST Monitoring and Testing Project by DBEDT will terminate effective June 30, 1994. Continued funding for SOH monitoring operations after June 30, 1994, shall be the responsibility of DLNR, including the proper plugging and abandonment of the SOHs and any site restoration, if required.

5. The Right of Entry License effective January 1, 1991 by and among the Trustees Under the Will and of the Estate of James Campbell, Deceased, and True/Mid-Pacific Geothermal Venture, and the University of Hawaii, for the Hawaii Natural Energy Institute; and the Revocable Right of Entry Agreement dated March 19, 1990 between Kapoho Land Partnership, A Limited Partnership, and Puna Geothermal Venture, and the University of Hawaii, for its Hawaii Natural Energy Institute shall be canceled.

   DLNR separately shall enter into agreements for rights of entry to the SOH sites with the Trustees Under the Will and of the Estate of James Campbell, Deceased; and with Kapoho Land Partnership, A Limited Partnership, and Puna Geothermal Venture.

6. HNEI shall coordinate and provide proper training of DLNR staff in the use and maintenance of the SOH monitoring equipment.

7. All permit obligations/conditions, explicit or otherwise, are hereby assumed by DLNR.

In witness whereof, the parties hereto have executed this Agreement effective as of the date first above written.

DEPARTMENT OF LAND AND NATURAL RESOURCES

By _____
Its Chairperson

DEPARTMENT OF BUSINESS, ECONOMIC DEVELOPMENT & TOURISM

By _____
Its Director

HAWAII NATURAL ENERGY INSTITUTE OF THE UNIVERSITY OF HAWAII

By _____
Its Director

APPROVED AS TO FORM:

_____
Deputy Attorney General
State of Hawaii

MONITORING BUDGET

Estimated one year monitoring budget for SOH 1, 2 and 4 and KA1-1:

Equipment Installation @ KA1-1	
1. Pruett installation w/slickline	$10,000
2. Drilling Engineer to supervise	4,000
Equipment Maintenance @ SOH 1, 2 and 4	
1. Pruett to remove/reinstall	15,000
2. Drilling Engineer to supervise	5,000
3. Computers	2,000
Site Maintenance @ KA1-1, Access Road and SOHs	
$1,500/month x 12	18,000
Supplies	3,000
Travel	1,000
Miscellaneous Items	3,000
Contingency	10,000
TOTAL	$70,000

THE ESTATE OF JAMES CAMPBELL

RECEIVED

89 MAR 17 A 8:32

DIV. OF WATER & LAND DEVELOPMENT

March 15, 1989

Department of Land and Natural Resources
Division of Water and Land
STATE OF HAWAII
P. O. Box 373
Honolulu, Hawaii 96809

Attention: Mr. Manabu Tagamori, Chief

Re: State Geothermal Mining Lease

Gentlemen:

This is to inform you of the lease arrangement between The Estate of James Campbell (Lessor) and True/Mid-Pacific Geothermal Venture (Lessee) as it relates to the State geothermal mining lease for Campbell Estate lands at Puna, Hawaii. The mining lease will be issued to and held by The Estate with the rights and obligations of the mining lease subleased to True/Mid-Pacific Geothermal Venture. Attached please find the applicable parts of the agreement that address this situation.

While the State Mining Lease will continue to be held by The Estate, True/Mid-Pacific Geothermal Venture will have all the rights and obligations granted thereunder for as long as the agreement between us continues.

Please call me if you have any questions or if I can further clarify the situation.

Sincerely,

Russell W Alger

Russell W Alger
Director, Hawaii Properties

cc: Rod Moss, Mid-Pacific Geothermal
Alan Kawada, True Geothermal Energy Co.

Attachment

emy:1293

Suite 500, 828 Fort Street Mall, Honolulu, Hawaii 96813-4380 (808) 536-1961

RECEIVED
94 MAY 17 A11 : 06
DEPT. OF WATER & LAND DEVELOPMENT

THE PELE DEFENSE FUND
POST OFFICE BOX 404 • VOLCANO, HAWAII 96785
PHONE: (808) 935-1663 • FAX: (808) 935-3551

TO: Director, OSP
☑ PLEASE COORDINATE with DLNR

FOR:
___ Comment/Recommendation (required)
___ Appropriate attention
___ Direct reply (cc/bcc: Governor)
___ Your information/file
_✓_ Draft reply for Governor's signature
___ Follow up/report
___ Submit copy of response (if any)
___ Keep enclosure(s)
___ Return enclosure(s)
___ Other

Gov, JA
DUE seven working days from MAY 1 7 1994
(If delay is encountered in meeting suspense date, please advise by telephone immediately)
In reply, please refer to: 94.692016

Honorable John Waihee
Governor, State of Hawai'i
State Office Tower
Honolulu, Hawai'i 96813

Dear Governor Waihee:

Aloha. Now that the lease of True Geothermal to Wao Kele O Puna has terminated and the company has withdrawn from drilling activities in the forest, we, in the Pele Defense Fund are writing to request a meeting to discuss permanent protection of Wao Kele O Puna. As in past meetings we would like to include Keith Ahue of the Department of Land and Natural Resources and Liebert Landgraff currently with the Office of State Planning (OSP) ourselves, Mark Luning, Davianna McGregor and Margaret McGuire.

In the meeting, we would like to discuss the possibility of reversing the land exchange of Wao Kele O Puna for Kahauale'a between the Campbell Estate and the Board of Land and Natural Resources. The land exchange was justified by True Geothermal and the Campbell Estate as necessary for the development of the Hawai'i Geothermal Project for the public benefit. Now that True Geothermal has pulled out and the U.S. Department of Energy has announced that the Hawai'i Geothermal Project is terminated, there is little hope for a 500 megawatt cable project proceeding. Without the Hawai'i Geothermal Project for which the land exchange was consummated, the land exchange should be reversed. Given the conditions for which Wao Kele was exchanged, it seems that the Campbell Estate would have little use for the land, other than to dedicate it for conservation. If Kahauale'a reverts back to the Campbell Estate, then it may be possible for them to sell it to the federal government for inclusion within Hawai'i Volcanoes National Park. This would enable them to recoup some of their losses.

If Wao Kele O Puna is reinstated within the ceded public lands trust then it would be possible to reinstate it into the Natural Area Reserve System (NARS) or to provide a protected status for it as a cultural reserve similar to the status of the island of Kaho'olawe. We have long dreamed of creating a Cultural Area Reserve System to protect land resources which are critical for

DLNR REF. NO. 96

traditional Hawaiian subsistence. In our discussions in your OSP Kaho'olawe Planning Committee we had indicated that Kaho'olawe could be the first of many cultural reserves throughout our islands. The Ethnographic Study for the Puna district, conducted by professors Davianna McGregor, Jon Matsuoka, and Luciano Minerbi has documented the cultural significance and use of Wao Kele O Puna, actually of the entire Puna Forest Reserve, by Hawaiians living in the Puna district. Even if the land exchange is not reversed we would like to have the state initiate discussions with Campbell Estate to consider dedicating the forest under the NARS or for a cultural reserve. Perhaps the Office of Hawaiian Affairs could be asked to assist in the effort to reinstate Wao Kele O Puna into the ceded public lands trust.

Your office may contact Davianna McGregor at 956-7068 to schedule the meeting. We look forward to being able to meet with you and discuss, Hawaiian to Hawaiian, the protection of our cultural and natural resources and the Pele beliefs, customs and practices for our future generations. Aloha.

With Lifelong Commitment,

Palikapu Dedman Noa Emmett Aluli, M.D.
for the Pele Defense Fund

JOHN WAIHEE
Governor
MUFI HANNEMANN
Director
JEANNE SCHULTZ
Deputy Director
RICK EGGED
Deputy Director
TAKESHI YOSHIHARA
Deputy Director

DEPARTMENT OF BUSINESS, ECONOMIC DEVELOPMENT & TOURISM

ENERGY DIVISION, 335 MERCHANT ST., RM. 110, HONOLULU, HAWAII 96813 PHONE: (808) 587-3800 FAX: (808) 587-3820

94:513

March 18, 1994

MEMORANDUM

TO: Manabu Tagomori, Manager and Chief Engineer
Division of Water and Land Development
Department of Land and Natural Resources

FROM: Maurice H. Kaya
Energy Program Administrator

SUBJECT: Memorandum of Agreement (MOA) for the Transfer of the Scientific Observation Holes (SOHs)

To facilitate your efforts to acquire the SOHs for geothermal resource monitoring, we have enclosed a MOA for the proposed transfer of the SOHs from the Hawaii Natural Energy Institute (HNEI) to the Department of Land and Natural Resources (DLNR). The MOA has been approved by the Attorney General's office and has been signed by Dr. Patrick Takahashi for HNEI. Subsequent to approval of the transfer by the Board of Land and Natural Resources (BLNR), we would appreciate your forwarding the MOA to the Chairperson for signature.

As detailed in letters from DBEDT to Dr. Takahashi dated February 9, 1994 and February 28, 1994, copies of which were transmitted to you, the MOA includes provisions requested by both DLNR and the University of Hawaii's Procurement & Property Management Office.

We would appreciate your return of the signed document to the Geothermal Project Office at 130 Merchant Street, Suite 1060, Honolulu, Hawaii 96813. Thank you for your continued cooperation and should you have any questions with regard to the MOA, please contact Dean Nakano at 586-2353.

MHK:dan
Enclosure

MEMORANDUM OF AGREEMENT

Relating to the Transfer of the Scientific Observation Holes

This Agreement, effective the _____ day of _____, 1994 is entered into by and between the Department of Land & Natural Resources (DLNR), the Department of Business, Economic Development & Tourism (DBEDT), and the Hawaii Natural Energy Institute of the University of Hawaii (HNEI).

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2. DLNR, in its discretion, may continue the SOH downhole pressure monitoring program and/or initiate any other monitoring program utilizing the SOHs.

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In witness whereof, the parties hereto have executed this Agreement effective as of the date first above written.

DEPARTMENT OF LAND AND NATURAL RESOURCES

By _____
Its Chairperson

DEPARTMENT OF BUSINESS, ECONOMIC DEVELOPMENT & TOURISM

By _____
Its Director

HAWAII NATURAL ENERGY INSTITUTE OF THE UNIVERSITY OF HAWAII

By _____
Its Director

APPROVED AS TO FORM:

_____
Deputy Attorney General
State of Hawaii

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
Division of Water and Land Development
Honolulu, Hawaii

March 24, 1994

Board of Land and Natural Resources
State of Hawaii
Honolulu, Hawaii

Transfer of Scientific Observation Holes for Geothermal Resource Monitoring and Assessments at Kilauea East Rift Zone, Hawaii

Background

Between 1989 and 1991, the Department of Business, Economic Development & Tourism (DEBDT) made funds available to Hawaii Natural Energy Institute to drill three scientific observation holes (SOH). Three wells were drilled under Hawaii County Geothermal Resource Permit (GRP) of August 8, 1989. The purpose of these scientific observations holes was to assess subsurface geological conditions, ground water level and composition, temperature, and drilling conditions, inventory possible mineral and geothermal resources and develop the eruptive history of the island to the depth drilled. Since the completion of drilling, the SOH's have been instrumented to provide data relating to reservoir productivity. Funding from DBEDT is no longer available for continued monitoring. Monitoring should continue, however, so that in combination with data from existing geothermal wells, a current picture of reservoir conditions and productivity can be maintained.

Staff Analysis

The Division of Water and Land Development is responsible for developing and monitoring a model of the geothermal reservoir as part of its regulatory role in managing the geothermal resources of the Kilauea East Rift Zone. The Division has determined, in conjunction with its Geothermal Technical Advisory Committee (GeoTAC) scientific advisors that it is important to gather deep reservoir data to determine the availability of geothermal resources and best management practices through a network of monitoring wells. Efforts made to date for monitor wells include the drilling of thee scientific observation holes, GeoTAC scientists gaining permission to monitor various wells on the Puna Geothermal Venture (PGV) site, and GeoTAC exploring the possibility of the State monitoring other geothermal wells that are not being utilized.

The SOH wells present an excellent opportunity to gain additional data points which would be valuable for monitoring the geothermal reservoir that includes the resource tapped by PGV's 25 megawatt electrical generating facility. In addition to temperature and pressure, other characteristics such as steams and water chemistry, meteorological data, and seismicity can be monitored at this site. The three SOH observation holes would provide additional baselines for these key parameters that are unaffected by geothermal production. Any data that might indicate changes in fluid chemistry, seismicity, magma movement, or deep hydrology (reservoir pressure and temperature) could, with a high degree of confidence, be presumed to be natural in origin. It would therefore yield baseline information and would indicate whether any changes on PGV's site are regional or associates with production activities. Continued monitoring of the SOH observation holes would also extend many

Approved by the Board of
Land & Natural Resources
at its meeting held on
MAR 24 1994

ITEM D-1

already promising studies to further refine models of rift seismicity and reservoir dynamics, thus improving the Division's ability to effectively manage geothermal resources.

Comparatively, it would cost the State about $4 million to construct monitor wells at each SOH well site.

The alternative to the State's taking over the SOH wells for monitoring purposes would be for DBEDT to plug and abandon the wells, per State regulations. However, once a well is plugged, it is lost forever for monitoring purposes. This is the case with other geothermal wells drilled and abandoned in the past.

Monitoring the SOH holes will be performed by the Department cooperative with the University of Hawaii using existing equipment and personnel. Therefore, no additional resources would be required.

Summary and Conclusions

It is in the State's interest to take over the SOH wells for geothermal reservoir monitoring in order to better understand the geothermal reservoir.

RECOMMENDATION

That the Board authorize the Department to enter into a Memorandum of Agreement with DBEDT and the Hawaii Natural Energy Institute of the University of Hawaii to transfer the SOH wells for monitoring purposes and authorize the Chairperson to sign all documents pertaining thereto.

Respectfully submitted,

MANABU TAGOMORI
Manager-Chief Engineer

APPROVED FOR SUBMITTAL:

KEITH W. AHUE, Chairperson

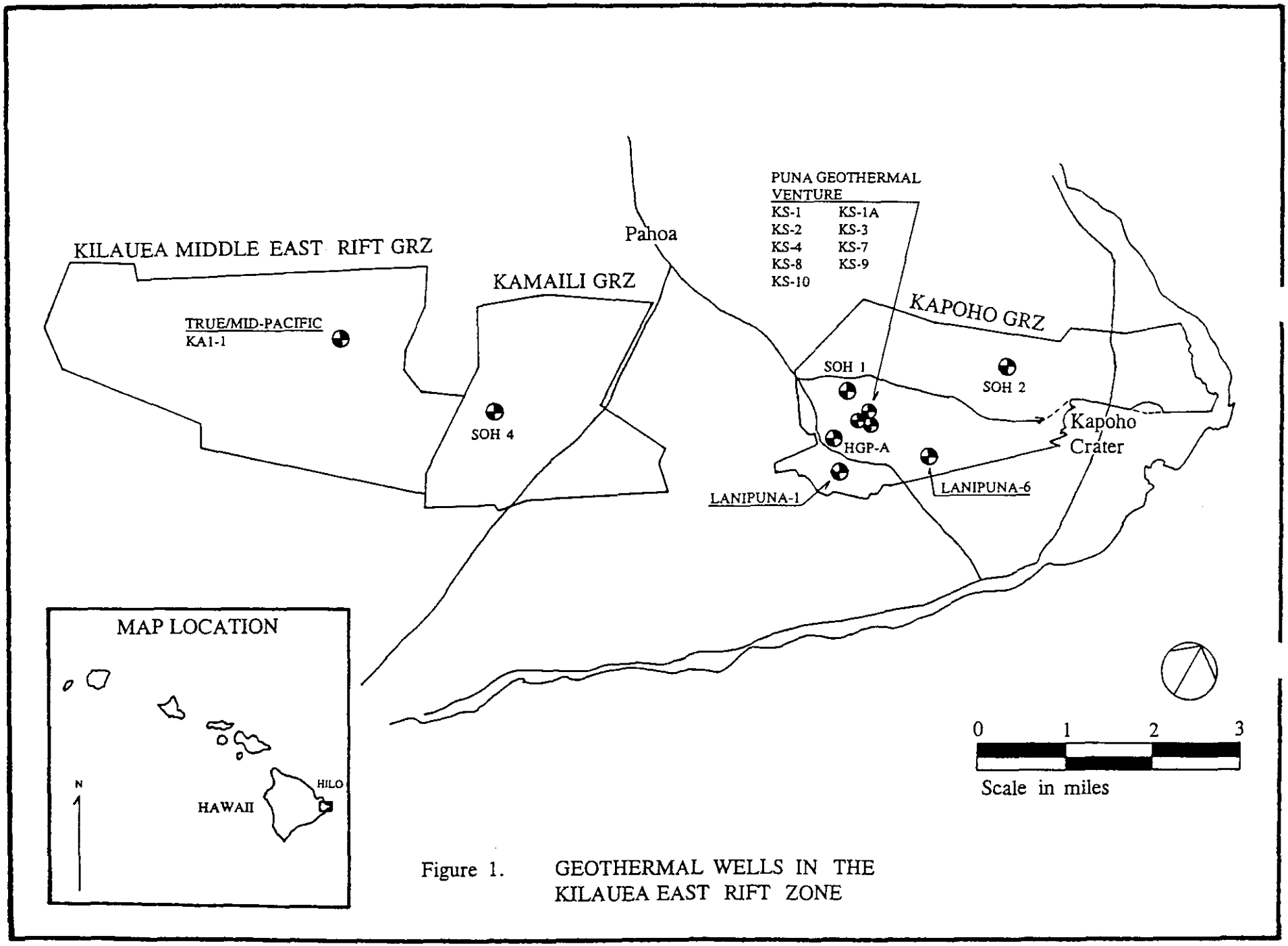

Figure 1. GEOTHERMAL WELLS IN THE KILAUEA EAST RIFT ZONE

JOHN WAIHEE
GOVERNOR OF HAWAII

KEITH W. AHUE, CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES

DEPUTIES

JOHN P. KEPPELER, II
DONA L. HANAIKE

AQUACULTURE DEVELOPMENT PROGRAM
AQUATIC RESOURCES
CONSERVATION AND ENVIRONMENTAL AFFAIRS
CONSERVATION AND RESOURCES ENFORCEMENT
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FORESTRY AND WILDLIFE
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STATE PARKS
WATER AND LAND DEVELOPMENT

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
P.O. BOX 621
HONOLULU, HAWAII 96809

REF:WL-EK

APR 25 1994

Kapoho Land Partnership
26 Waianuenue Avenue
Hilo, Hawaii 96720

Memorandum of Agreement for Geothermal Well Monitoring

We would like to enter into a long-term Geothermal Well Monitoring agreement with the Estate of James Campbell to enter and occupy True/Mid-Pacific Geothermal Well KA1-1 and Hawaii Natural Energy Institute's Scientific Observation Hole-4 (SOH-4) which are located on your property for the purpose of establishing a network of monitoring wells in the Kilauea East Rift Zone.

The Geothermal Well Monitoring agreement should contain the following points:

1. Right to enter and use approximately 10,000 square feet surrounding the KA1-1 and SOH-4 well sites and the use of the access road to the two sites.

2. Maintenance of the KA1-1 and SOH-4 well sites surface area and access road to the two sites will be the responsibility of the State.

3. Maintenance and structural integrity of KA1-1 and SOH-4 will be the responsibility of the State.

4. Use of KA1-1 and SOH-4 only for monitoring purposes. No commercial use of the well should be allowed.

5. Term of monitoring activities should initially cover ten (10) years with option to extend.

6. Plugging and abandonment of the wells and site restoration upon completion of monitoring term will be the responsibility of the State.

Should you have any questions regarding this request, please have your staff contact Mr. Manabu Tagomori of the Division of Water and Land Development at 587-0230.

Very truly yours,

KEITH W. AHUE

c: DLNR, Land Management
DBEDT
Christopher Yuen,
Hawaii Land Board Member

JOHN WAIHEE
Governor
MUFI HANNEMANN
Director
RICK EGGED
Deputy Director
JEANNE K. SCHULTZ
Deputy Director
TAKESHI YOSHIHARA
Deputy Director

DEPARTMENT OF BUSINESS, ECONOMIC DEVELOPMENT & TOURISM

Central Pacific Plaza, 220 South King Street, 11th Floor, Honolulu, Hawaii
Mailing Address: P.O. Box 2359, Honolulu, Hawaii 96804 Telephone: (808) 586-2406 Fax: (808) 586-2377

94:539

June 29, 1994

TO: The Honorable Keith Ahue, Chairman
Board of Land and Natural Resources

FROM: Mufi Hannemann MH

SUBJECT: Memorandum of Agreement for the Transfer of the Scientific Observation Holes

The Memorandum of Agreement (MOA) for the transfer of the Scientific Observation Holes (SOHs) from the University of Hawaii's Hawaii Natural Energy Institute (HNEI) to the Department of Land and Natural Resources (DLNR) has been executed by all parties and a copy is enclosed for your files.

In fulfillment of the MOA terms and conditions, HNEI has completed the required training of DLNR staff in the use and maintenance of the SOH monitoring equipment and has initiated the transfer of all SOH-related equipment to DLNR. We are pleased that the transfer will allow the continued use of the SOHs for your department's regulatory and resource management activities.

With regard to your Division of Water and Land Development's request for $70,000 to monitor the SOHs and the True/Mid-Pacific well (KA1-1), we are unable to provide any funding at this time. However, we remain committed to assisting your department in securing future legislative appropriations in support of your geothermal monitoring program.

Thank you for your cooperation and assistance in this matter. Should you have any questions, please contact Dr. Takeshi Yoshihara, Deputy Director, at 586-2365.

Enclosure

cc: Manabu Tagomori

MEMORANDUM OF AGREEMENT

Relating to the Transfer of the Scientific Observation Holes

This Agreement, effective the 15th day of June, 1994 is entered into by and between the Department of Land & Natural Resources (DLNR), the Department of Business, Economic Development & Tourism (DBEDT), and the Hawaii Natural Energy Institute of the University of Hawaii (HNEI).

BACKGROUND

Three Scientific Observation Holes (SOH) were drilled by HNEI to advance understanding of the geothermal resource along the Kilauea East Rift Zone (KERZ), Island of Hawaii. Funding for the SOH Program was provided under State of Hawaii Contracts No. 24271 and No. 25751, both of which expired on 7/1/93. Continued support of state regulatory and resource management functions has been provided through data collection and downhole pressure monitoring of the SOHs conducted under State of Hawaii Contract No. 33272. Funding for this monitoring activity will terminate on June 30, 1994.

The Geothermal Well Drilling Permits issued by DLNR for SOH-1, -2 and -4, dated August 31, 1989 require that the SOHs be "plugged and abandoned in accordance with Administrative Rules, Chapter 13-183" when the SOHs are no longer used for monitoring purposes. In addition, the Geothermal Resource Permit (GRP 89-1) issued by the Hawaii County Planning Commission (and DLNR Well Drilling Permits) requires that the SOH sites be restored as near as possible to their original condition after operations are completed.

DLNR has the responsibility and authority for regulation of geothermal resource subzones and management of the geothermal resource. DLNR's responsibilities include, but are not limited to, regulation of well construction and operation to prevent waste, conserve resources, and for safety and protection of the environment. DLNR also monitors and regulates operations relative to geothermal exploration and development, modification of geothermal wells, well abandonment, and associated data collection activities.

The statutory function and responsibility of DBEDT, through its Director as the Energy Resources Coordinator, is to plan and coordinate energy programs within the state. Towards that end, DBEDT formulates plans and programs for the optimum and safe utilization of Hawaii's geothermal energy resources which include developing and recommending programs to facilitate research, assessment, and resource management activities.

HNEI serves as the technology research and development arm of the University of Hawaii's School of Ocean and Earth Science and Technology (SOEST). In implementing the SOH Program, HNEI administered permit acquisition, drilling operations, data collection, and monitoring activities related to assessment of the geothermal potential of the KERZ.

PURPOSE

The purpose of this Memorandum of Agreement (MOA) is to identify and set forth the terms and conditions for the transfer and assignment of responsibility for the Scientific Observation Holes from HNEI to DLNR. The continued monitoring of the SOHs is necessary to DLNR's regulatory and resource management responsibilities. Execution of this MOA will provide for the orderly transfer of the SOHs and the continuance of all monitoring operations and maintenance responsibilities for the SOHs and related equipment to DLNR.

TERMS AND CONDITIONS

1. DLNR assumes responsibility for management, monitoring, and long-term maintenance of the SOHs. DLNR also assumes responsibility for downhole pressure monitoring equipment, including any retrieval, cleaning, and/or storage of such equipment upon satisfaction of all equipment transfer requirements and receipt of applicable documentation.

2. DLNR, in its discretion, may continue the SOH downhole pressure monitoring program and/or initiate any other monitoring program utilizing the SOHs.

3. DLNR assumes responsibility for any required permits or approvals, including compliance with any landowner notification/agreements required for continued access, monitoring, maintenance, and final disposition of the SOHs, including proper plugging/abandonment of the SOHs and site restoration, if required.

4. Funding of the SOEST Monitoring and Testing Project by DBEDT will terminate effective June 30, 1994. Continued funding for SOH monitoring operations after June 30, 1994, shall be the responsibility of DLNR, including the proper plugging and abandonment of the SOHs and any site restoration, if required.

5. The Right of Entry License effective January 1, 1991 by and among the Trustees Under the Will and of the Estate of James Campbell, Deceased, and True/Mid-Pacific Geothermal Venture, and the University of Hawaii, for the Hawaii Natural Energy Institute; and the Revocable Right of Entry Agreement dated March 19, 1990 between Kapoho Land Partnership, A Limited Partnership, and Puna Geothermal Venture, and the University of Hawaii, for its Hawaii Natural Energy Institute shall be canceled.

   DLNR separately shall enter into agreements for rights of entry to the SOH sites with the Trustees Under the Will and of the Estate of James Campbell, Deceased; and with Kapoho Land Partnership, A Limited Partnership, and Puna Geothermal Venture.

6. HNEI shall coordinate and provide proper training of DLNR staff in the use and maintenance of the SOH monitoring equipment.

7. All permit obligations/conditions, explicit or otherwise, are hereby assumed by DLNR.

In witness whereof, the parties hereto have executed this Agreement effective as of the date first above written.

DEPARTMENT OF LAND AND NATURAL RESOURCES

By _____
Its Chairperson

DEPARTMENT OF BUSINESS, ECONOMIC DEVELOPMENT & TOURISM

By _____
Its Director

HAWAII NATURAL ENERGY INSTITUTE OF THE UNIVERSITY OF HAWAII

By _____
Its Director

APPROVED AS TO FORM:

_____
Deputy Attorney General
State of Hawaii

JOHN WAIHEE
GOVERNOR OF HAWAII

KEITH W. AHUE, CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES

DEPUTIES

JOHN P. KEPPELER, II
DONA L. HANAIKE

AQUACULTURE DEVELOPMENT PROGRAM
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HISTORIC PRESERVATION
LAND MANAGEMENT
STATE PARKS
WATER AND LAND DEVELOPMENT

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
DIVISION OF WATER AND LAND DEVELOPMENT
P. O. BOX 373
HONOLULU, HAWAII 96809

MAY 16 1994

TO: Mr. Maurice H. Kaya
Energy Program Administrator, Energy Division
Department of Business, Economic Development & Tourism

FROM: Manabu Tagomori, Manager & Chief Engineer
Division of Water and Land Development

SUBJECT: Transfer of Scientific Observation Holes

This is in response to your May 2, 1994 memorandum regarding the transfer of the Scientific Observation Holes (SOHs).

Based on the Land Board's approval of the transfer and our review of the Agreement, we have no objections to finalizing the transfer of the SOHs to our department.

However, prior to executing the transfer Agreement, we need to get as a bare minimum some assurance that the two landowners do not object to our continued use of the SOHs for monitoring purposes. To date, we have sent letters to Campbell Estate and Kapoho Land Company requesting permission to enter into a long-term Geothermal Well Monitoring Agreement and we have not yet received responses. In view of this, we would appreciate your patience until May 31, 1994, so that we may follow-up on our letters to them.

We would certainly appreciate your consideration and are aware the urgency of this matter.

JOHN WAIHEE
Governor
MUFI HANNEMANN
Director
JEANNE SCHULTZ
Deputy Director
RICK EGGED
Deputy Director
TAKESHI YOSHIHARA
Deputy Director

DEPARTMENT OF BUSINESS, ECONOMIC DEVELOPMENT & TOURISM

ENERGY DIVISION, 335 MERCHANT ST., RM. 110, HONOLULU, HAWAII 96813 PHONE: (808) 587-3800 FAX: (808) 587-3820

94:519

May 2, 1994

MEMORANDUM

TO: Manabu Tagomori, Manager and Chief Engineer
Division of Water and Land Development

FROM: Maurice H. Kaya
Energy Program Administrator

SUBJECT: Transfer of the Scientific Observation Holes (SOHs)

On March 24, 1994, the Board of Land and Natural Resources approved the transfer of the SOHs from the Hawaii Natural Energy Institute of the University of Hawaii to the Department of Land and Natural Resources. As discussed at the Geothermal Technical Advisory Committee (GEOTAC) meeting on November 16, 1993, the timely completion of the transfer is essential to planning the allocation of funds for follow-on projects under our contract with the University's School of Ocean & Earth Science & Technology (SOEST).

Unless the transfer is fully executed by May 15, 1994, funds for plugging and abandonment of the SOHs will be reserved from the contract budget and plugging/abandonment proceedings will be initiated. On-going projects including, but not limited to, the Geochemistry Program (Thomas) may terminate and new projects proposed for FY 95 will not be approved due to the reduction of available funding. Accordingly, the collection and analysis of geothermal reservoir and ground water data will be curtailed with the suspension of current monitoring operations.

The Principal Investigators for the SOEST contract who currently serve on the GEOTAC have not been able to plan or make commitments to their staff due to the uncertainty of continued funding for FY 95 and, as a result, have lost or will lose essential personnel currently assigned to the SOEST Geothermal Monitoring, Research and Testing Program. As such, it is imperative that matter of the transfer of the SOHs be resolved as soon as possible so that these GEOTAC members may be informed of the status of their project funding.

Should you have any questions concerning the above, please contact me at 587-3807 to discuss the matter further. Thank you for your continued cooperation.

cc: Dr. Donald Thomas
Dr. Harry Olson
Dr. Patricia Cooper
Dr. Thomas Hulsebosch
Dr. Aly El-Kadi
Mr. Richard Longfield

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
Division of Water and Land Development
Honolulu, Hawaii

March 24, 1994

Board of Land and Natural Resources
State of Hawaii
Honolulu, Hawaii

Transfer of Scientific Observation Holes for Geothermal Resource Monitoring and Assessments at Kilauea East Rift Zone, Hawaii

Background

Between 1989 and 1991, the Department of Business, Economic Development & Tourism (DEBDT) made funds available to Hawaii Natural Energy Institute to drill three scientific observation holes (SOH). Three wells were drilled under Hawaii County Geothermal Resource Permit (GRP) of August 8, 1989. The purpose of these scientific observations holes was to assess subsurface geological conditions, ground water level and composition, temperature, and drilling conditions, inventory possible mineral and geothermal resources and develop the eruptive history of the island to the depth drilled. Since the completion of drilling, the SOH's have been instrumented to provide data relating to reservoir productivity. Funding from DBEDT is no longer available for continued monitoring. Monitoring should continue, however, so that in combination with data from existing geothermal wells, a current picture of reservoir conditions and productivity can be maintained.

Staff Analysis

The Division of Water and Land Development is responsible for developing and monitoring a model of the geothermal reservoir as part its regulatory role in managing the geothermal resources of the Kilauea East Rift Zone. The Division has determined, in conjunction with its Geothermal Technical Advisory Committee (GeoTAC) scientific advisors that it is important to gather deep reservoir data to determine the availability of geothermal resources and best management practices through a network of monitoring wells. Efforts made to date for monitor wells include the drilling of thee scientific observation holes, GeoTAC scientists gaining permission to monitor various wells on the Puna Geothermal Venture (PGV) site, and GeoTAC exploring the possibility of the State monitoring other geothermal wells that are not being utilized.

The SOH wells present an excellent opportunity to gain additional data points which would be valuable for monitoring the geothermal reservoir that includes the resource tapped by PGV's 25 megawatt electrical generating facility. In addition to temperature and pressure, other characteristics such as steams and water chemistry, meteorological data, and seismicity can be monitored at this site. The three SOH observation holes would provide additional baselines for these key parameters that are unaffected by geothermal production. Any data that might indicate changes in fluid chemistry, seismicity, magma movement, or deep hydrology (reservoir pressure and temperature) could, with a high degree of confidence, be presumed to be natural in origin. It would therefore yield baseline information and would indicate whether any changes on PGV's site are regional or associates with production activities. Continued monitoring of the SOH observation holes would also extend many

ITEM D-1

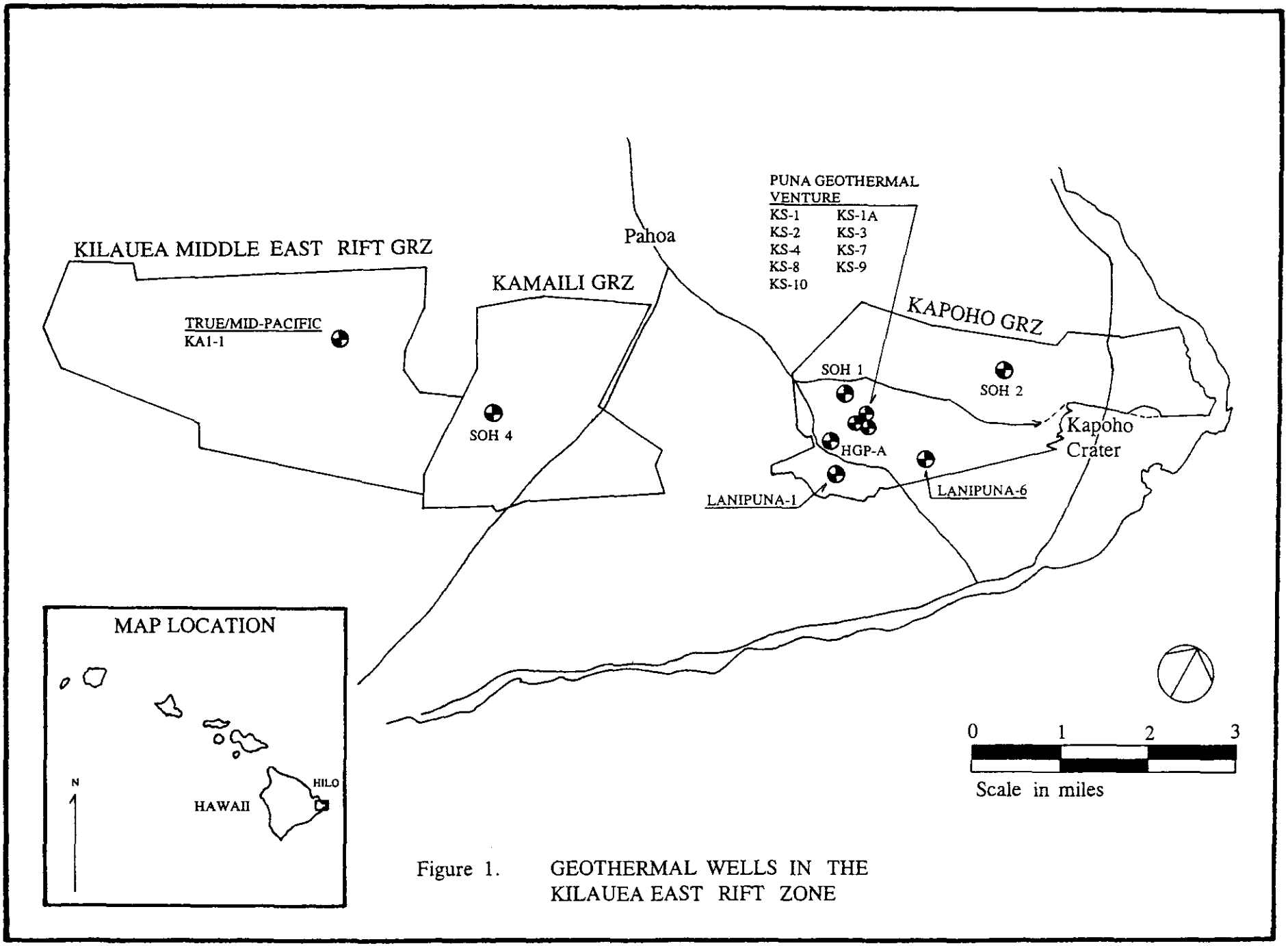


Figure 1. GEOTHERMAL WELLS IN THE KILAUEA EAST RIFT ZONE

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
Division of Water and Land Development
Honolulu, Hawaii

March 24, 1994

Board of Land and Natural Resources
State of Hawaii
Honolulu, Hawaii

Use of Well KA1-1 for Geothermal Resource Monitoring and Assessment at Kilauea Middle East Rift Zone, Hawaii

Background

Under CDUA Decision and Order No. HA-12/20/85-1830 dated April 11, 1986, Campbell Estate and True/Mid-Pacific Geothermal Venture (True) received permission to conduct geothermal exploratory activities to determine the existence of a geothermal resource capable of providing up to 25 megawatts of electrical power within the Kilauea Middle East Rift Geothermal Resource Subzone. Campbell Estate, which has an operating agreement with True, was issued a Geothermal Mining Lease R-5 dated 23 July 1987. True has developed well KA1-1 but has decided to cease operations and has no further plans to utilize the well. True's decision not to utilize well KA1-1 presents the State the opportunity to take over the well for geothermal resource monitoring and assessment purposes. The Division of Water and Land Development and Department's Geothermal Technical Advisory Committee (GeoTAC) recommends that the State of Hawaii monitor as many deep geothermal wells as possible in order to best manage the geothermal resources of the Kilauea East Rift zone (KERZ).

Staff Analysis

The Division of Water and Land Development is responsible for developing and monitoring a model of the geothermal reservoir as part of its regulatory role in managing the geothermal resources of the Kilauea East Rift Zone. The Division has determined, in conjunction with its GeoTAC scientific advisors that it is important to gather deep reservoir data to determine the availability of geothermal resources and best management practices through a network of monitoring wells. Efforts made to date for monitor wells include the drilling of three scientific observation holes, GeoTAC scientists obtaining permission to monitor various wells on the Puna Geothermal Venture (PGV) site, and GeoTAC exploring the possibility of the State monitoring other geothermal wells that are not being utilized.

Well KA1-1 presents an excellent opportunity to gain an additional data point which would be valuable for monitoring the geothermal reservoir that includes the resource tapped by PGV's 25 megawatt electrical generating facility. In addition to temperature and pressure, other characteristics such as steam and water chemistry, meteorological data, and seismicity can be monitored at this site. KA1-1 would provide a baseline for these key parameters that are unaffected by geothermal production. Any data that might indicate changes in fluid chemistry, seismicity, magma movement, or deep hydrology (reservoir pressure and temperature) could, with a high degree of confidence, be presumed to be natural in origin. It would therefore yield baseline information and would indicate whether any changes on PGV's site are regional or associated with production activities. Monitoring KA1-1 would also extend many already promising studies to further refine models of rift seismicity and reservoir dynamics, thus improving the Division's ability to effectively manage geothermal resources.

Approved by the Board of Land & Natural Resources at its meeting held on MAR 24 1994

ITEM D-2

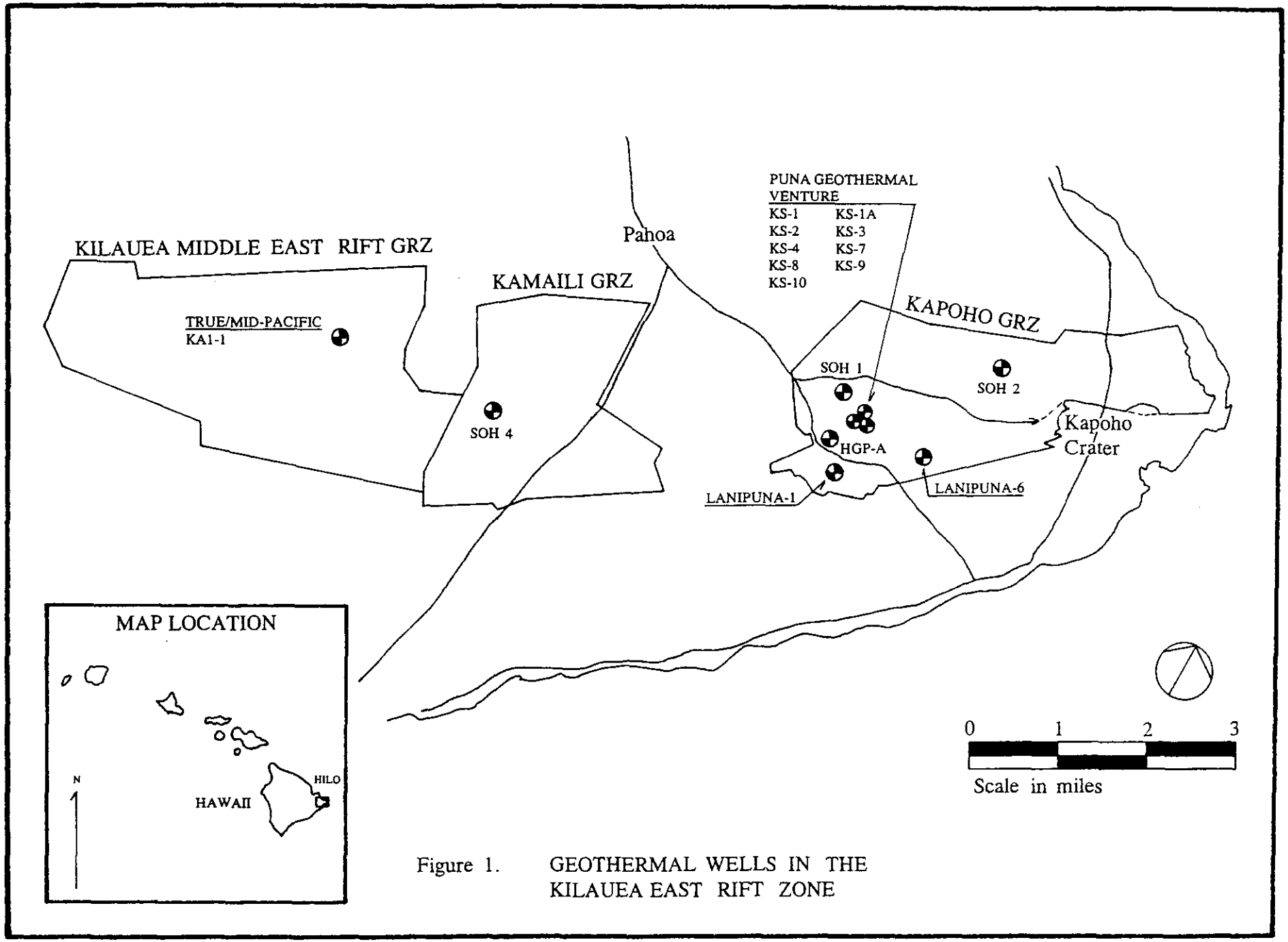


Figure 1. GEOTHERMAL WELLS IN THE KILAUEA EAST RIFT ZONE

Rationale for acquiring KA1-1 as a monitoring hole

1. What can be monitored

1. Temperature
2. Pressure
3. Steam and/or water geochemistry
4. Meteorological data
5. Seismicity
6. Reservoir dynamics

2. Why these elements should be monitored

1. Would provide a baseline for monitoring characteristics at depth that is unaffected by geothermal production. There would be a high confidence level that observed data and any changes would be natural.

2. Natural data could indicate changes in geochemistry, magma movement, deep hydrology

3. Would provide a comparison with PGV operations, i.e., if a change at PGV is observed, is it regional or related to PGV's site and/or associated activities?

4. Seismic monitoring would extend the already promising studies at the HGP-A area to generate a broader picture of rift seismicity and possible reservoir fluid presence and dynamics. Also, other government agencies with regulatory responsibilities could use it and contribute to data pool for resource monitoring.

University of Hawaii at Manoa

Hawaii Natural Energy Institute
Holmes Hall 246 • 2540 Dole Street • Honolulu, Hawaii 96822

14 April 1994

Mr. Manabu Tagomori, P.E.
Manager and Chief Engineer
Division of Water and Land Development
Department of Land and Natural Resources
P.O. Box 373
Honolulu, Hawaii 96809

Subject: Integrity of the Scientific Observation Holes (SOH)

Dear Mr. Tagomori:

Prior to the installation of the pressure monitoring equipment currently in the Scientific Observation Holes (SOH), the SOHs were checked, cleaned, and conditioned, and were found to be free of any obstructions that could be interpreted as tubing or casing failure. Since that time the wellheads have been cleaned and painted and are checked at monthly intervals during the down-loading of the pressure data. Nothing in the pressure data to date indicates that the SOHs have failed in any way. As such, it is my professional opinion that the Scientific Observation Holes (SOH) are in sound shape and the wellheads are in good working condition..

The SOHs will continue to be checked at approximately monthly intervals during the course of the pressure monitoring program. I believe it would be remiss at this time to interrupt the monitoring program and to incur the added expense of checking the integrity of the SOHs. The SOHs can be checked at the time the instruments in the holes are removed or upgraded.

Sincerely,

Harry J Olson

m/SOHINTEG

JOHN WAIHEE
Governor
MUFI HANNEMANN
Director
JEANNE SCHULTZ
Deputy Director
RICK EGGED
Deputy Director
TAKESHI YOSHIHARA
Deputy Director

COPY

DEPARTMENT OF BUSINESS, ECONOMIC DEVELOPMENT & TOURISM

ENERGY DIVISION, 335 MERCHANT ST., RM. 110, HONOLULU, HAWAII 96813 PHONE: (808) 587-3800 FAX: (808) 587-3820

February 9, 1994

Dr. Patrick Takahashi, Director
Hawaii Natural Energy Institute
University of Hawaii at Manoa
Holmes Hall 240G
2540 Dole Street
Honolulu, Hawaii 96822

Dear Dr. Takahashi:

In my letter to you dated November 29, 1993, a Draft Memorandum of Agreement (MOA) for the proposed transfer of responsibility for the Scientific Observation Holes (SOH) was transmitted for your review. The MOA was intended to formalize an agreement which would allow the SOH wells to be utilized for continued data collection and downhole pressure monitoring in support of the regulatory and resource management functions of the Department of Land and Natural Resources (DLNR). Recently, I was informed by Manabu Tagomori, Manager-Chief Engineer of the Division of Water and Land Development, that DLNR will assume ownership of and responsibility for the SOH wells subject to the following conditions:

(1) The transfer of the right of entry to DLNR for the SOH wells pursuant to:

   (i) The Right of Entry License effective January 1, 1991 by and among the Trustees Under the Will and of the Estate of James Campbell, Deceased, and True/Mid-Pacific Geothermal Venture, and the University of Hawaii, for the Hawaii Natural Energy Institute, and

   (ii) The Revocable Right of Entry Agreement dated March 19, 1990 between Kapoho Land Partnership, A Limited Partnership, and Puna Geothermal Venture, and the University of Hawaii, for its Hawaii Natural Energy Institute.

(2) The transfer of downhole pressure monitoring equipment and appropriate documentation from the University to DLNR, and

(3) Proper training of DLNR staff in the use and maintenance of the SOH monitoring equipment.

In order to effectuate this transfer, we request that the University of Hawaii, through the Hawaii Natural Energy Institute, initiate all necessary actions to transfer the rights of entry and monitoring equipment to DLNR and coordinate training of DLNR staff as appropriate. It is our desire to complete the transfer of the SOH wells as soon as possible since the current Monitoring and Testing Project will terminate on June 30, 1994.

The additional conditions described above have been incorporated in the revised MOA enclosed for your signature. We would appreciate your return of the signed document to Dean Nakano at the Geothermal Project Office, 130 Merchant Street, Suite 1060, Honolulu, Hawaii, 96813.

In order for the transfer to be executed in a timely fashion, your immediate attention to this matter is requested. Thank you for your continued cooperation and should you have any questions, please call Dean Nakano at 586-2353.

Sincerely,

Maurice H. Kaya
Energy Program Administrator

Enclosure

cc: Harry J. Olson
Manabu Tagomori

JOHN WAIHEE
Governor
MUFI HANNEMANN
Director
JEANNE SCHULTZ
Deputy Director
RICK EGGED
Deputy Director
TAKESHI YOSHIHARA
Deputy Director

DEPARTMENT OF BUSINESS, ECONOMIC DEVELOPMENT & TOURISM

ENERGY DIVISION, 335 MERCHANT ST., RM. 110, HONOLULU, HAWAII 96813 PHONE: (808) 587-3800 FAX: (808) 587-3820

94:513

March 18, 1994

MEMORANDUM

TO: Manabu Tagomori, Manager and Chief Engineer
Division of Water and Land Development
Department of Land and Natural Resources

FROM: Maurice H. Kaya
Energy Program Administrator

SUBJECT: Memorandum of Agreement (MOA) for the Transfer of the Scientific Observation Holes (SOHs)

To facilitate your efforts to acquire the SOHs for geothermal resource monitoring, we have enclosed a MOA for the proposed transfer of the SOHs from the Hawaii Natural Energy Institute (HNEI) to the Department of Land and Natural Resources (DLNR). The MOA has been approved by the Attorney General's office and has been signed by Dr. Patrick Takahashi for HNEI. Subsequent to approval of the transfer by the Board of Land and Natural Resources (BLNR), we would appreciate your forwarding the MOA to the Chairperson for signature.

As detailed in letters from DBEDT to Dr. Takahashi dated February 9, 1994 and February 28, 1994, copies of which were transmitted to you, the MOA includes provisions requested by both DLNR and the University of Hawaii's Procurement & Property Management Office.

We would appreciate your return of the signed document to the Geothermal Project Office at 130 Merchant Street, Suite 1060, Honolulu, Hawaii 96813. Thank you for your continued cooperation and should you have any questions with regard to the MOA, please contact Dean Nakano at 586-2353.

MHK:dan
Enclosure

JOHN WAIHEE
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
P.O. BOX 621
HONOLULU, HAWAII 96809

KEITH W. AHUE, Chairperson
BOARD OF LAND AND NATURAL RESOURCES

DEPUTIES

JOHN P. KEPPELER, II
DONA L. HANAIKE

AQUACULTURE DEVELOPMENT PROGRAM
AQUATIC RESOURCES
CONSERVATION AND ENVIRONMENTAL AFFAIRS
CONSERVATION AND RESOURCES ENFORCEMENT
CONVEYANCES
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION
LAND MANAGEMENT
STATE PARKS
WATER AND LAND DEVELOPMENT

REF:WL-EK

Mr. Allan G. Kawada
True Geothermal Energy Company
Central Pacific Plaza, Suite 868
220 South King Street
Honolulu, Hawaii 96813

Dear Mr. Kawada:

KA1-1 Plug and Abandonment Plan

Your KA1-1 Well Abandonment Plan, dated January 4, 1994, submitted on February 9, 1994 is hereby approved. The Geothermal Well Abandonment Permit is attached.

Please notify us in writing of the proposed start date for abandonment activities.

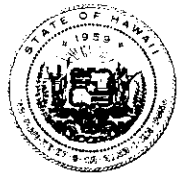
Should you have any questions on this matter, please contact Mr. Manabu Tagomori of the Division of Water and Land Development at 587-0230.

Very truly yours,

KEITH W. AHUE

Enc.

JOHN WAIHEE
GOVERNOR OF HAWAII



STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
P.O. BOX 621
HONOLULU, HAWAII 96809

GEOTHERMAL WELL ABANDONMENT PERMIT

True/Mid-Pacific KA1-1
Puna, Hawaii

TO: True Geothermal Energy Company
Central Pacific Plaza
220 South King Street, Suite 868
Honolulu, Hawaii 96813

Your application dated January 4, 1994, for a permit to abandon Geothermal Well True/Mid-Pacific KA1-1 is approved.

Well Designation: True/Mid-Pacific KA1-1
Location: TMK 1-2-10:03, Puna, Hawaii (Drilling Site 1)
Leased to: Estate of James Campbell (GRML R-5)
Subleased to: True/Mid-Pacific Geothermal Venture
Operator: True Geothermal Energy Company
Ground Elevation: 1,500 ft. +/- Above Mean Sea Level
Total Measured Depth: 7850 ft.

Approval is granted in accordance with the Department's Administrative Rules, Chapter 13-183, HAR, and under the following conditions:

(1) All work shall be performed in accordance with your KA1-1 Plug and Abandonment Plan, dated January 4, 1994, the Department's Administrative Rules (Chapters 13-183 and 13-184, HAR), and all other applicable Federal, State and County laws, ordinances, and regulations;

(2) The permittee, his successors and assigns shall indemnify and hold the State of Hawaii harmless from and against any loss, liability, claim or demand for property damage, personal injury and death arising out of any act or omission of the permittee, assigns, officers, employees, contractors and agents under this permit or relating to or connected with the granting of this permit;

(3) Except for the surface plug, all cement used for the plugging operations shall contain a high temperature resistant admix as set forth in Section 13-183-83 (a), HAR. In addition, good quality, heavy drilling fluid shall be used to fill portions of the well above the bottom most plug not plugged with cement;

(4) Subsequent to plugging and abandonment operations, the casing shall be cut off at least six feet below ground surface and all concrete cellars and other structures (e.g., fencing) removed;

(5) The permittee shall obtain the Chairperson's approval prior to any changes to the abandonment program;

(6) A history of the well and an as-abandoned diagram of the well shall be filed within sixty days of the abandonment;

(7) The permittee shall notify the Department, in writing, of the date of the start of work;

(8) The bond covering the well shall remain in full force and effect until the well is properly abandoned and the site properly restored; and

(9) This permit shall expire 365 days from the date of issuance.

KEITH W. AHUE, Chairperson
Department of Land and Natural Resources

Date of Issuance

c: Land Board Members
Hawaii County Planning Dept
DBEDT
Dept. of Health
OEQC, DOH

True/Mid-Pacific Geothermal Venture

Well KA1-1
Abandonment Plan

ThermaSource, Inc.

1-4-94

Pertinent Data

1. Well KA1-1 was spudded on November 17, 1989.

2. 30" conductor pipe was set in a 42" hole to a depth of 90' below Kelly Bushing.

3. 20", 94 ppf, K-55, Buttress casing set in a 26" hole to a total depth of 704' below Kelly Bushing. 20" casing cemented to surface using Class G Cement.

4. 13-3/8" casing was set in 2 phase, 1st a liner made up of 78 joints (2389') of 72 ppf, L-80, Buttress casing set in a 17-1/2" hole hung from the 20" by means of a 20" X 13-3/8" Midway liner hanger set at 448' in the 20" to a depth of 3370' and cemented across entire interval. 2nd phase set as a tie-back made up of 12 joints (452') of 68 ppf, L-80, Buttress casing and cemented from total depth to the surface.

5. A section was cut from the 13-3/8" casing from 2728' to 2778'. The well was then sidetracked out section and 12-1/4" hole drilled to 5350.

6. 9-5/8", 47 ppf, L-80, Buttress casing set as a liner in the 12-1/4" hole hung from 2485' using a 13-3/8" X 9-5/8" Midway liner hanger. Ran 74 joints (2820.74') of 9-5/8" casing and cemented across entire interval.

7. 8-1/2" open hole drilled to a total depth of 7850'.

8. 7" combination blank and slotted liner (12 joints of 26 ppf blank above 56 joints of 26 ppf slotted) hung in the 8-1/2" open hole from 5115' to total depth of 7850'.

9. Well completed and suspended on 10-14-90.

10. Potential hole in 13-3/8" casing from 1774' to 1782'.

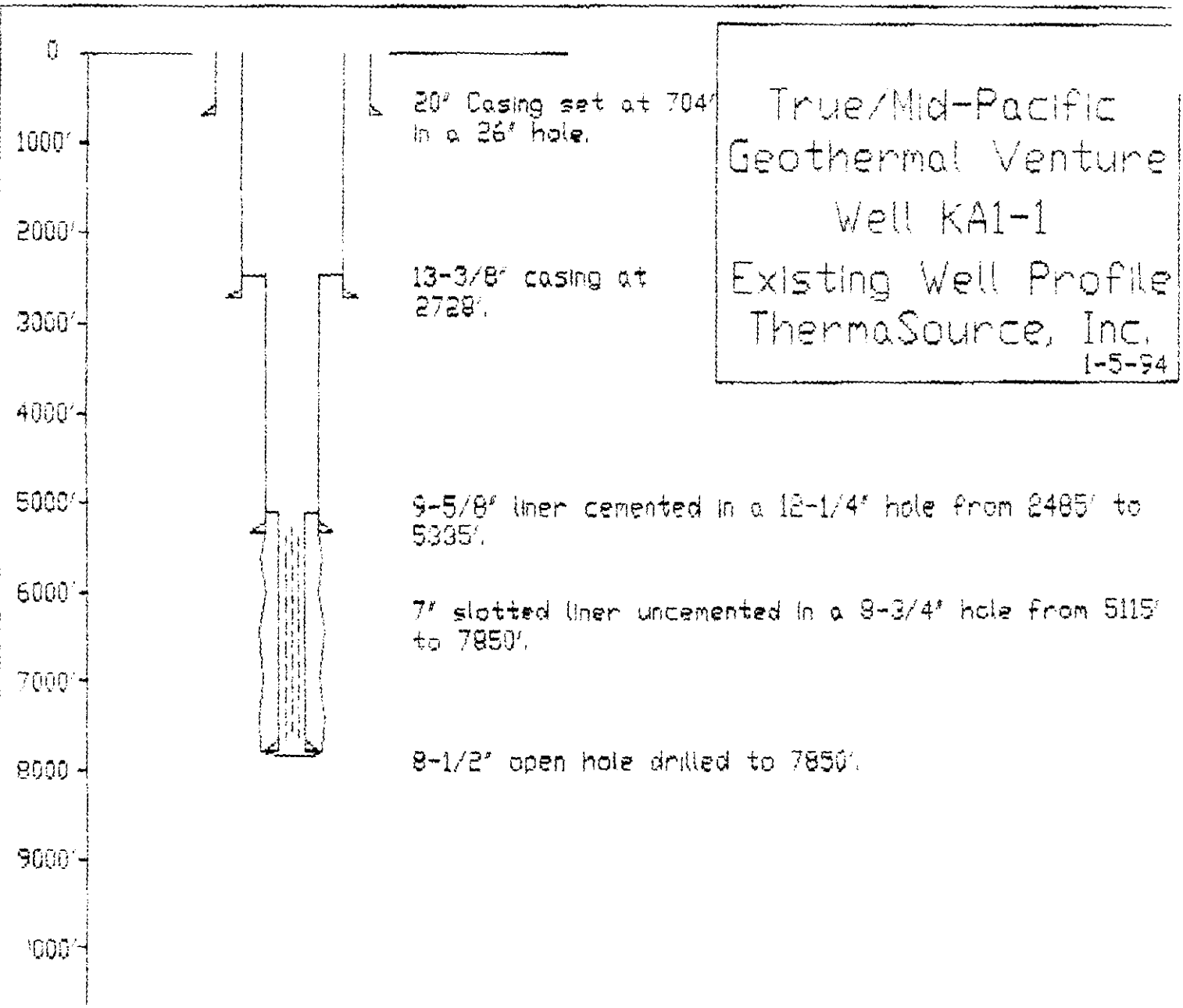
Abandonment Procedure

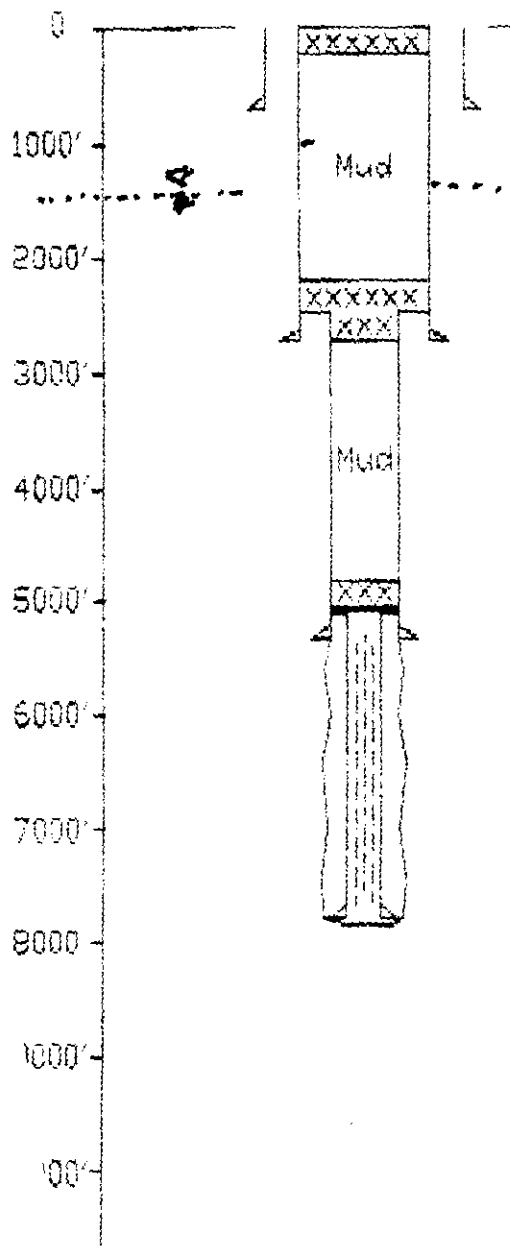
Time		Sequences of Operations
	1.	Prepare location for appropriate rig to complete abandonment procedure.
0.5 days	2.	Install blow out preventer stack consisting of hydraulically controlled dual ram-type preventers equipped with CSO rams and Pipe rams.
4.0 days	3.	Move in rig to abandon well. Install flowline on top of blow out preventer stack. Rig up rig and test stack. Start pumping water and mud down well to insure well is dead. Bleed off any gas pressure that may have accumulated below master valve.
0.5 days	4.	Open well and pick up 8-1/2" bit and run in hole with drill pipe of tubing to top of 7" slotted liner at 5110' to insure cement retainer can be run to setting point.
0.5 days	5.	If successful in running bit to 5110' then trip out of hole and lay down bit and pick up Halliburton EZSV cement retainer and run in hole with retainer on drill pipe to setting point and set same, then proceed to step 6 of this procedure. If unsuccessful in running bit to 5110' setting depth, attempt to determine cause for stoppage, determination should be made as soon as possible on location by drilling personnel present and State Representative to remove cause of stoppage or alter abandonment procedure.
0.5 days	6.	After EZSV cement retainer is set at 5110' mix and pump enough High Temperature cement retarder to hole conditions to fill 100 linear feet in 8-1/2" hole through retainer and then full out of retainer. Fill hole with mud above retainer. Mix and pump enough High Temperature cement to fill 200 linear feet of 9-5/8" casing and displace cement to be place directly on top of retainer. Pull out of cement plug and wait on cement for 8 hours.

		Run and tag top of cement to verify location of plug.
0.5 days	7.	Pull up in hole with opened ended drill pipe and set second cement plug from 2385' to 2585'. 200 linear feet plug straddling top of 9-5/8" liner located at 2485'. Pull out of cement plug and pull above top of cement and wait for 8 hours. Tag top of cement and verify location. Pressure up on 13-3/8" casing above cement plug at 2385' to 750 psi. If casing holds pressure proceed with abandonment, if casing leaks then locate leak with packer and squeeze off same with cement. Note: If 13-3/8" does not hole pressur above cement plug at 2385' an available option would be to set an additional 13-3/8" EZSV cement retainer above the leak and plug well with cement above the retainer. See optional procedure below.
0.25 days	8.	Pull up in hole to 100' and set surface cement plug in 13-3/8" casing from 100' to 6' below wellhead.
0.5 days	9.	Wait on cement while laying down drill pipe. Feel for cement and if cement is in place then nipple down blow out preventers.
0.5 days	10.	Cut off and remove master valves and wellhead assembly. Cut and remove casing below ground level and weld plate on top of casing.
1.0 days	11.	Rig down and remove rig from location.
	12.	Fill in cellar and mark location of wellhead. Restore location.
8.75 days		Total time on Location including Rig up and down

Optional Procedure to Abandon well above 13-3/8" casing leak

Time		Sequence of Operations
0.5 days	1.	Locate leak using 13-3/8" Halliburton RTTS if 13-3/8" casing does not hold pressure above cement plug at 2385'. Pull out of hole with RTTS, pick up and run in hole with 13-3/8" EZSV on bottom of drill pipe and set same approximately 50' above leak.
0.5 days	2.	Mix and pump approximatley 100 linear feet of cement below EZSV then mix and pump enough cement to fill 100' of 13-3/8" casing on top of the EZSV. Pull out of cement and wait on cement. Tag top of cement after 8 hours and pressure test remaining 13-3/8" casing above plug.
	3.	Proceed to Step 8 of above Abandonment Procedure.
1.0 days		Additional Time Required if 13-3/8" casing contain leaks.


0
1000'
2000'
3000'
4000'
5000'
6000'
7000'
8000'
9000'
20" Casing set at 704' in a 26" hole.
13-3/8" casing at 2728'.
9-5/8" liner cemented in a 12-1/4" hole from 2485' to 5335'.
7" slotted liner uncemented in a 8-3/4" hole from 5115' to 7850'.
8-1/2" open hole drilled to 7850'.
True/Mid-Pacific Geothermal Venture
Well KA1-1
Existing Well Profile
ThermaSource, Inc.
1-5-94



Surface Abandonment
Cement plug 0 to 100'.
20" Casing set at 704'
in a 26" hole.

Cement Plug set from
2385' to 2585'.

13-3/8" casing at
2729'.

True/Mid-Pacific Geothermal Venture
Well KA1-1
Abandonment Plan
ThermaSource, Inc.

1-5-94

9-5/8" liner cemented in a 12-1/4" hole from 2485' to 5335'.

Halliburton EZSV Cement Retainer set in 9-5/8" Casing at 5110'. Cement set above EZSV from 5110' up to 4910'.

7" slotted liner uncemented in a 8-3/4" hole from 5115' to 7850'.

8-1/2" open hole drilled to 7850'.

DRAFT

April 20, 1991

Memo To: File

From: Donald Thomas

Subject: Long term geothermal assessment and management program

There are four general objectives that can be pursued under the State's geothermal program:

1) Assessment of the geothermal resources on the Kilauea East Rift Zone;

2) Identification and evaluation of geothermal resources throughout the Island of Hawaii or State-wide;

3) Long-term management of the resource development to ensure optimum use and longevity of the available resource base;

4) Assessment and management of the impacts of long term production/reinjection on groundwater quality within the hydrologic environment of the hydrothermal system;

Given those possible objectives, an essential step in the evaluation or management of the geothermal resource is the development of a model of the geothermal reservoirs under consideration. To be of any use, the model should provide information on the dimensions of the reservoir, its temperature distribution, the rate of heat input, the rate of heat discharge, the permeability distribution within the reservoir, the sources of water supplying the reservoir and the composition of the fluids within the reservoir. Realistically, it is unlikely that the State or any developer will be able to gather all the information that will be needed to develop a complete model of the geothermal reservoirs in Hawaii prior to development. However, the information that could come from the SOH and commercial drilling currently underway could greatly improve our understanding of the resource and almost certainly help reduce the frequency of the unfortunate surprises that PGV and True/Mid-Pacific have encountered during the last twelve months.

Listed below are the types of analyses that could contribute to the development of a model for Hawaii's geothermal resources that would help us make informed decisions regarding the extent of the resource base how it should be developed. In those cases where the purpose of the analysis is not obvious, I've noted what it can contribute to our understanding of the resource; those activities that are currently being done are noted as well as who is pursuing the work. For those unfamiliar with the specifics of geophysics and geochemistry, I've included an appendix with a slightly more detailed description of what the particular techniques involve and what they can contribute to the program.

Although it is clear that the State cannot fully pursue all of the activities listed below, what follows can be a starting point for discussion of those things that are the most critical and cost effective for the State to support in order to obtain a realistic assessment of Hawaii's geothermal resources.

SCIENTIFIC OBSERVATION HOLE PROGRAM I.

OBSERVATION HOLE DRILLING

SOH-1 and 4 have been drilled, SOH-2 is underway (HNEI)

ANALSYIS OF CORE

core descriptions: complete for SOH-1 and SOH-4, SOH-2 underway (HNEI)

develop a data base with descriptive data in it; currently underway (HIG/HNEI)

structural analysis of core - strike and dip of fractures (correlate with chemistry of alteration?); strike, dip, and abundance of dikes; transition from subaerial to submarine basalts;

detailed analysis of core mineralogy - infer fluid chemistry and sources of fluids; progress and extent of alteration; temperature history; preliminary work just initiated (HIG).

analysis of fluid inclusions - infer fluid chemistry and evolution of the hydrothermal temperatures and chemistry

chemical and isotopic analysis of core - define fluid compositions and course of alteration within rift; in SOH-4, determine whether we are in ML or KERZ

magnetic susceptibility of core - calibrate aeromag data (being done by USGS)

ANALYSIS OF HOLES

downhole logging - temperature, caliper (formation competence), spinner (internal flow within hole), gamma (alteration/chemistry variations), borehole televiewer (structure, fracture frequency and orientation, stress state), resistivity (formation fluid chemistry)

reservoir engineering (i)- injection testing (clean out, do staged injection, focus on deep aquifers); water level/pressure monitoring (possibly with isolation of shallow part of hole); long term interference tests (resource management); preliminary injection tests run but very little information obtained from reservoir levels (HNEI).

reservoir chemistry (i) - downhole sampling (after the holes have been cleaned out and purged) analysis of elemental composition and isotopic composition of fluids - determine source of fluids, correlate with alteration mineralogy, estimate water/rock ratios, prospect for acid fluids, non condensable gas (H_2S, CO_2) concentrations

ANALYSIS OF HOLES (cont.)

reservoir engineering (ii) - perform production testing of the SOH holes to attempt to infer formation productivity

reservoir chemistry (ii) - sampling and analysis of fluids and gases produced by the holes during production testing

downhole geophysics - mise-a-la-mass surveys (resistive anomalies associated with reservoir fluids); downhole seismic surveys such as: tomography to map dike system or magma bodies; passive seismic to map current fracture distributions and define stress state of the rift; reflection/refraction seismology to analyze the structure around the holes; vertical seismic profiling to look deeper in the rift for magma bodies and better define its structure

PRIVATE WELLS/COLLABORATION WITH INDUSTRY

downhole logging - borehole televiewer, spinner, resistivity

fluid chemistry - major ion and isotopic analysis (fluid sources, reservoir temperatures, production problems (silica, acidity, trace metals), changes in reservoir characteristics with time/production volumes

reservoir engineering - interference testing to determine the degree of communication among wells in the rift and infer reservoir production capacities

surface geophysical surveys (see below) - ground truth developed by commercial drilling to calibrate surface geophysical surveys

SURFACE EXPLORATION PROGRAM I. Kilauea East Rift Zone

gravity surveys - model the width of the rift zone; look for effects of alteration; define the signature of the dike complex; look for intersection with Mauna Loa ERZ

magnetics - detailed modelling of earlier work (underway with USGS);

seismic - passive seismic monitoring (evaluate current fracturing patterns); ground noise monitoring (look for shallow boiling zones such as encountered by PGV); in the long-term, passive seismic monitoring may enable us to track reinjection fluid in the rift zone

self-potential - use subsurface hydrologic and chemistry data derived from commercial drilling to calibrate and model sp surveys (potential for mapping upflow zones)

geochemistry - analysis of shallow groundwater (elemental and isotopic) composition to determine the discharge rates of geothermal fluids and the interaction between deep fluid and shallow groundwater; this may also assist in characterizing upflow zones between saline (acid) and fresh (near neutral)

SURFACE EXPLORATION PROGRAM I. (cont.)

hydrology - water levels and temperatures in shallow groundwater wells - estimate the discharge rates of geothermal fluids, heat flow rates, and interaction between deep fluids and shallow groundwater table.

SURFACE EXPLORATION PROGRAM II. Island of Hawaii

aeromagnetics - detailed island wide survey (identify buried Mauna Loa east rift zone, assess depth of potential thermal anomalies, define zones of hydrothermal alteration)

gravity - detailed gravity surveys to map buried portion of rift zones and define breadth at depth

time domain electromagnetic surveys - assess resistivity anomalies that might be associated with thermal fluid discharges

geochemistry - evaluation of shallow groundwater compositions in an effort to identify geothermal discharges

SCIENTIFIC OBSERVATION HOLE PROGRAM II.

Site selection analysis of all of the above data to determine location of additional holes

Additional discussion of the techniques and what they could contribute to an analysis of the geothermal resources

Core descriptions: a "first look" at the rocks from the core holes that will tell us the nature of the rock encountered - whether flow basalt, dike, submarine basalts, or shallow water ash and to what degree it is altered - and, hence, whether there is likely to be a reservoir and a general idea of whether there will be sufficient permeability to have a productive reservoir and, if not, why not.

Core mineralogy: the minerals present in the altered portion of the core are a direct result of the fluids that passed through the rock and their temperature; a detailed analysis of the mineralogy can help us to indirectly determine whether fresh water or seawater was the primary alteration agent and whether the alteration occurred at high temperature or an intermediate temperature. (Note: the significance of the question of whether seawater or freshwater is present in the reservoir cannot be over emphasized: the presence of high concentrations of seawater in the reservoir fluids can make the difference between a relatively benign geothermal fluid such as was observed at HGP-A or a highly acid fluid that would be so corrosive that the well would be totally unusable.)

Chemical and isotopic analysis of core: these analyses would provide more definitive information on the source of alteration fluids and the extent of their reaction with the reservoir rocks - this is again further information the likelihood of encountering a viable reservoir; these analyses will also tell us whether we have drilled into the Mauna Loa shield or whether we have remained in Kilauea - this has strong implications for the extent of the reservoir to the north and may indicate whether we can tap into what might be far more productive rocks at depth than those so far found.

Magnetic susceptibility: the magnetic characteristics of Hawaii's basalts are highly dependent upon the rock density, the rock temperature and the degree of alteration that the rocks have undergone; it is already recognized that aerial magnetic surveys made from a low-flying light plane (aeromag surveys) can identify rift zones but, recent analyses of aeromag surveys performed by the USGS have indicated that it may be possible to delineate zones of hydrothermal alteration outside the rift zones. The ability to do this would help us define the lateral extent of the KERZ as well as other rifts that we may want to evaluate. Calibration of the aeromag data with direct measurements of the rock magnetic susceptibility would make a major contribution toward this effort.

Additional discussion of techniques (cont.)

Structural analysis of the core: the structure of the rift is the primary controlling factor over what fluids enter (fresh/seawater) the hydrothermal system, where they are discharged, and how production of fluids from one location will affect producibility of other areas; the structure will also allow us to predict whether there is likely to be any permeability within a given portion of the rift (e.g. if the dike complex is all intruded basalt, it is unlikely to be capable of producing any significant amounts of fluid.

Downhole logging encompasses a range of analyses of a drilled hole:
temperature - max temperature at dept is only one of the things this measurement can tell us; it can also give us an indication of whether there is significant permeability in the reservoir, whether there is natural inflow into the hole and where it is occurring, and whether there is surface discharge of hot hydrothermal fluids into the shallow groundwater table;
caliper - measures the hole diameter and, hence, tells us whether the rock is competent or if it has fallen apart around the drill bit and therefore is fractured, altered, or otherwise unable to hold together.
gamma - measures the natural radioactive emissions of the rocks around the borehole - can provide a continuous record of the degree of alteration of the rock within the hole and can help identify mineralized (altered) zones that may be productive.
borehole televiewer - a sonar "photograph" of the walls of the hole that can identify dikes, fractures, alteration zones, hole deviations that indicate the stress state of the rocks, and areas where hole stability is a problem. This tool can also orient the features so that we can identify the "fabric" of the rift and possibly allow improvements in the drilling strategy to preferentially encounter some features or avoid others.
resistivity - a continuous record of the formation fluid electrical conductivity which is a function of its salinity (fresh/seawater ratios)

Reservoir engineering: injection testing, if done properly, can give us a direct measurement of the permeability of the reservoir. The maximum amount of information could be derived from staged injection where water is injected into isolated zones within the hole so that a highly permeable aquifer won't simply overshadow the lower permeability zones at depth. This also presumes that the wells have been properly purged of drilling mud to allow the lower permeability aquifers to accept water.
water level monitoring - monitoring water levels in the deep wells will allow us to determine the level of connection between the surface groundwater table and the deeper aquifers, the permeability within the aquifers, and whether the development of the geothermal resource is having a significant effect on reservoir circulation patterns (interference testing).

Additional discussion of techniques (cont.)

Reservoir chemistry: direct measurement of fluid compositions to determine the source of fluids currently in the reservoir, whether they are acid or neutral and whether they are likely to turn acid after a period of production, what sort of engineering or environmental problems are likely to be associated with that portion of the reservoir, and what the circulation patterns, and possibly rates, are present in that region.

Downhole geophysics: mise-a-la-mass surveys map the resistivity of the subsurface around a well to give us an indication of the extent of the reservoir in direct connection with that particular well. A great deal of inference is involved and hence it is not a straightforward analysis.
downhole seismic surveys - involves the installation of seismometers of various types to substantial depths in a well and monitoring natural seismic activity as well as the reflected or refracted seismic waves generated by surface explosions. The data recovered can help identify currently active fractures, within or outside the rift, as well as the location and extent of the dike complex that supplies the heat and possibly the location of magma bodies beneath or within the rift zone.
vertical seismic profiling - is a downward looking technique that can tell us the structure of the rift zone below the the bottom of the wells - possibly to tell us the extent of the dike system and its associated heat source.

Flow testing - can give us direct evidence of the fluid compositions associated with production, the rates of flow that are likely to be encountered in a commercial sized hole and the depths from which production is likely to occur.

Gravity surveys - this technique is based on the idea that the gravitational field at a given location is a function of the density of the rock beneath the surface. Hence, measurements of the gravity field can identify the presence of the dense intrusive rocks that make up a rift system and help define its width, depth, and subsurface shape. In the case of Kilauea, it would help us to determine the northward extent of the rift zone beyond its currently active surface expression. With other volcanoes, it will help us to define their locations at lower elevations on the volcano where they, in some cases, become hard to trace.

Self-potential: this technique measures naturally induced changes in the earth's surface voltage that can arise from the presence of subsurface thermal anomalies or subsurface fluid flow. It is possible that this technique could help identify potentially productive upflow zones such as that encountered at the PGV Kapoho State 7 well.

Additional discussion of techniques (cont.)

Time-domain electromagnetic surveys: this technique is based on the ability of a conductive material to act as a transmitter for an electrical signal that it has just received. In this case, an electrical transmitter is laid out on the ground and transmits a high power radio signal into the ground; if a conductor is present at some depth below the surface, it will receive the signal and re-transmit it. Analysis of the retransmitted signal can provide information on the depth and the conductivity of the buried conductor. In our case, the conductor can be an aquifer carrying conductive hydrothermal fluids.

TO: Dean Anderson, Energy Division DBEL 8 May 1991

FROM: W. L. D'Olier RCUH4660066/WLD/4

TASK 1: Basis for Option to continue coring at SOH-2 if SOH-3 permit and site construction is delayed.

Operations at SOH-2 were proceeding effectively below 5600 feet with an NQ coring assembly (2.98" diameter corehole) as of May 7th. Total drilling costs of $818,793, reported as of 7 am, May 6th, seem projectable (adding 17% administrative costs) to a completion date on or about 23 May 1991 at an approximate total depth of 6170 feet and at the cost cap of $1,100,000 for SOH-2. Should SOH-2 complete as predicted, and SOH-3 location not be approved and constructed in time, consideration should be given to extending the coring activity at SOH-2 rather than paying standby charges on the Tonto rig for the following reasons:

1. Bottom hole temperatures in SOH-2, recorded by MRT while advancing HQ and NQ corehole, have demonstrated a favorable temperature increase (gradient) of approximately 19°F per 100 feet between 4150 and 5550 feet. If significant fracturing were encountered below the 471°F MRT value recorded at 5550 feet, SOH-2 could demonstrate a possible productive interval. The location of SOH-2 is central in the 7353-acre Kapoho GRS and is about 2 1/2 miles northeast of the PGV 25 MW Project. The finding of a high temperature (electric grade) permeable interval in SOH-2 would have important implications for the distinctive KERZ segment contained in this GRS.

2. Topography, aeromagnetic patterns and a recent phreatic eruptive style (1955) strongly indicate the Kapoho GRS to be different from the longer, middle KERZ segment which is uprift of the transverse structural break near the HGP-A production well. Rift structure in the Kapoho GRS is expected to be broader and more symmetrical in its transverse aspect because of the loss of the Mauna Loa buttress as Cape Kumukahi is approached. This perception raises the reasonable idea that permeable geothermal fluid zones might have a broader areal distribution here, particularly on the north flank of the KERZ. Deeper coring at SOH-2, especially in the increasing temperatures now prevailing, should contribute important new insights to this concept and to this increasingly prospective area.

3. If SOH-3 location is available in good time, SOH-2 should be completed if possible in a manner that will allow deepening at a later date by a resumption of NQ coring. A 7000-foot penetration at SOH-2 would be appropriate chiefly to encounter the 600-700°F temperature range of the production zones of the HGP-A and Kapoho-State geothermal wells.

MEMORANDUM

TO: Dean Anderson, Harry Olson and Don Thomas

FROM: W. L. D'Olier and K. P. Goyal- RCUH 4660066/kpg-wld/1

SUBJECT: Siting of Additional SOHs (Task 4)

DATE: May 7, 1991

SUMMARY OF ANALYSIS AND RECOMMENDATIONS:

With guidance and support from the comprehensive survey presented by Don Thomas in his memo of April 20, 1991, we assembled siting criteria for additional SOHs against objectives of the SOH and GRVC programs. We also weighted KERZ and GRS sites versus other options, resource assessment versus management priority and the results from SOH 4, 1 and 2 and key geothermal wells to reach our recommendations. Strong reasons were found to continue the focus of the SOH program in the KERZ. We believe that eight sites merit consideration for additional SOHs; these are presented as sites A through G on the attached location map and are discussed in detail in pages 5 through 8 of this memo.

SITING CRITERIA:

Siting criteria for new SOHs must consider multiple areas of concern. Scientific factors expectedly would predominate; however, political, economic and private operator activity are important inputs.

A. Scientific

1. Evaluation of scientific factors, processes and issues related to each recommended SOH site.

2. Potential contribution of the site in resolving the extent, magnitude and character of the geothermal resource.

3. Outlook for additional evaluation such as flow test, pressure monitor or injection test after the hole completion.

4. Proximity to other deep wells or SOH. Cross rift sections through deep boreholes promise to be of special value in rift zone evaluation.

5. Location within or outside the KERZ.

6. Seismic and volcanic hazards.

B. Political

1. Location and access impacts on sensitive land categories, rain forests and scenic values.

2. Prefer to minimize new road needs, ease of public access, and proximity to residences.

3. Public perception of objectives and scope of SOH program as it may be helped or hindered by the sites proposed.

4. New laws and regulations allow SOHs siting outside of GRS. Exercise this now or defer.

C. Economic

1. Roads, drilling location construction and water supply costs can become significant or prohibitive for some SOH sites.

2. Environmental mitigation may increase in complexity and costs at certain sites.

3. Site maintenance, security requirements and costs over SOH service life.

D. Private Operator Drilling Programs

1. Coordination with private geothermal exploration and development activity may provide significant help to SOH program objectives.

2. Private operators are drilling only on issued State geothermal mining leases inside of existing GRS.

PREFERRED KERZ SITING FOR ADDITIONAL SOHS:

We believe that a continued focus on the KERZ is appropriate to the State geothermal resource assessment objectives and the SOH program for the following reasons:

1. The KERZ is the most prospective geothermal resource trend known in Hawaii County. The 21 mile extent of the KERZ, from Pu'u O'o to Cape Kumakahi, actively functions as a major conduit for magma transport and as a host for high temperature dike emplacement. Substantial new knowledge of how this heat source is established and maintained has been gained from George Walker's studies of the exposed Koolau dike complex on

Oahu. The favorable implications for better understanding the thermal dynamics consequent to dike (heat source) emplacement within KERZ, which is very similar in size and structure to the fossil Koolau rift zone, are extraordinary.

2. An abundant subsurface supply of meteoric water should be delivered to the hot KERZ dike system by the heavy rainfall (200-100 inches per year) which enters Mauna Loa volcanic edifice and ground water transport regime. No other volcanic rift zone in the State has this mass and quality of water directed toward its prospective thermal core.

3. The KERZ is gaining world wide geothermal industry recognition for a possible major utilization potential for electric power. Five international consortiums chose to respond in November 1989 to the RFP concept of a 500 MW power supply to be won from KERZ geothermal energy and delivered by submarine cable to Oahu. A new approximation of available potential in the 500 to 700 MW range, presented by Russell James of New Zealand DSIR was presented in August 1990.

4. Three geothermal resource subzones, comprising approximately 21,900 acres of surface lands open for geothermal development along the KERZ, are now being evaluated by deep drilling by two private developers and the State. The momentum of expanding resource information, production wellfield completion and generating plant construction is mounting each month. The operating profile of the SOH Program is positive and is improving as a helpful stimulus to the higher cost and risk activity of the private developers. Multiple new testing procedures will involve the completed SOHs in the near term. Additional funding in the SOH Program will win higher return and earlier payback in the KERZ.

5. A final and unique reason for the recommended focus in the KERZ is the transverse asymmetry imposed on all elements across the rift by its northern buttressed foundation on the Moana Loa volcanics and southern exposure to sea water intrusion. Critical differences in diking, stress fields, deformation, structural style and hydrology exists between north and south flanks. SOH drilling merits a paired hole approach that reveals the distinctive separate character of the two flanks. Our siting recommendations reflect this reality.

SITING INSIDE OR OUTSIDE OF GEOTHERMAL RESOURCE SUBZONES:

We believe that initial effort should focus in the existing subzones for the following reasons.

1. The extent and productivity of the geothermal resource remains largely unknown in the existing three subzones: Kapoho,

Kamaili and Kilauea Middle East Rift subzone areas.

2. The HGP-A well and the ORMAT 25 MW project is expected to exploit only some 600 acres of the 7353-acre Kapoho GRS. The extent of the productive geothermal reservoir is not known in the greater part (92%) of this GRS.

3. An encouraging geothermal exploration well was drilled in the 9014-acre Kilauea GRS by True Mid Pacific in 1990. High temperatures and modest indication of 100% steam flows were encountered in this first and only well in this GRS. The SOH Program could obtain a major advance in resource assessment objectives by completing a transverse pair of SOHs in the vicinity of this important well.

4. The 5531-acre Kamaili GRS has yet to be drilled by private operators. Additional SOHs, prompted by the 583 F temperatures found in SOH 4 at 6562' total depth, should be pressed to win transverse data controls. Favorable flowrate results should induce private drilling.

CHARACTERIZATION VERSUS MANAGEMENT OF THE GEOTHERMAL RESOURCE DEVELOPMENT:

Presently, the State's main task should be to characterize the geothermal resource in the KERZ. The question of management of the resource development comes later after some areas have been developed and produced and sufficient data related to the reservoir response to production have been collected and analyzed.

PRELIMINARY ANALYSIS OF TEMPERATURES AND PERMEABILITIES IN SOH 4 AND SOH 1:

A cross-section (A-A' in Figure 1) through existing SOHs is presented in Figure 2 for isotherms and permeable zones as a function of depth. A similar plot as a function of elevation is shown in Figure 3. These figures indicate that

1. Permeable zones of variable thickness and permeability exist in both holes SOH 1 and SOH 4.

2. Downhole temperatures of about 400 F at 5500' depth and 585 F at 6500' depth have been measured in SOH 1 and SOH 4 respectively. These temperatures are encouraging but short of the 650 F found in HGP-A and Kapoho State wells.

3. Both permeability and temperatures tend to migrate deeper in SOH 1 compared to SOH 4. This may have been caused by the structure or by the hydrologic controls or both.

4. These plots suggest the need to drill deeper SOHs on the north flank of KERZ to assess the geothermal resource there.

PROPOSED SITES FOR ADDITIONAL SOHS

The locations of the proposed SOHs discussed here are shown in Figure 1.

SOH-A

Proposed 6500' SOH in Kamaili subzone, at a location just north of GTW II, a 556' hole yielding the hottest shallow ground water (207 F) yet encountered in KERZ.

1. GTW II aligns on a 1955 fissure lava extension that may be a local south boundary of rift structure.

2. SOH A would be a cross rift mate to SOH 4 which found 583 F bottom hole temperature at 6562' TD. SOH A and 4 would be about 1.3 miles apart.

3. Both SOH A and 4 appear to be on or near a cross rift linear identified in aeromagnetic mapping.

4. A convenient road leading to Ilewa Crater should afford easy and low cost access to a drillsite.

5. SOH A site would be inside Kamaili GRS. Plan to use flow test option for evaluation.

SOH-B

Proposed 6500' SOH in Kamaili GRS at a location 5/8 mile east of Heileiahulu volcanic vent.

1. SOH B, near south rift boundary, would be a cross rift mate to SOH 3 and expected additional geothermal well drilling by True/Mid Pacific.

2. Heileihulu was cited by R. Moore, 1983 as an inferred locale for a magma chamber.

3. SOH B would locate between two cross rift linears identified in aeromagnetic mapping.

4. Trail road through Upper Kaimu Homestead may allow access to drillsite on agricultural land within Kilauea Middle East Rift GRS.

5. Plan to use flow test option for evaluation.

SOH-C

Proposed SOH 4 redrill; northwest course to 7000' TD

1. Consider redrill preferably after a possible flow test evaluation of existing vertical borehole to 6562' TD.

2. Redrill could provide valuable insight to rock alterations, fracturing and permeability variation with borehole positioning on the KERZ north flank.

3. Second utilization of existing location and quality casing of SOH-4 should allow minimal cost for redrilling.

4. Much touted, directional drilling capacity of the Tonto UDR 5000 rig needs execution and evaluation at an early date.

5. Plan to use flow test option for evaluation. Special value could attach to successful flow test in both the original hole and proposed redrill at SOH 4. Fortunately the relatively secluded location of SOH-4 should favor flow testing.

6. The possible encounter of permeable, high temperature zones in either or both SOH-4 redrill or SOH A should prompt deep geothermal exploratory well drilling by a private developer in Kamaili GRS.

SOH-D

Proposed 7500' SOH at location approximately 1 1/2 miles north of PGV Kapoho State 30 MW Project.

1. Deep penetration deliberately intended at SOH D to identify contact of Kilauea volcanics on underlying Mauna Lao equivalents.

2. Evaluate the depth of the meteoric (ground water) regime that may have a vigorous presence in this locale. Plan a flow test of this fluid if it can be isolated at depth.

3. SOH D, expected to be down structure from both SOH-1 and 2, should reveal some implications for the concept of a broadened prospective area on the KERZ, east of the transverse break in the HGP-A well area. Should SOH-2 encounter permeability and high temperatures before its target depth of 6000 feet, SOH-D would become a most logical follow up to properly assess the Kapoho GRS.

4. An existing road should allow an easy access and site selection for SOH D.

SOH-E

Proposed 6500' SOH about 1.5 miles southeast of SOH-2 and just southwest of Kapoho Crater and within the Kapoho GRS.

1. SOH E would be the south edge, cross rift mate to SOH-2.

2. The Kapoho Crater has drawn some conflicting interpretations about a possible underlying magma chamber; only drilling is likely to sort this out.

3. Easy access is indicated by existing road and topography; the surface may be farmed.

4. Plan flow testing as an evaluation option.

SOH-F

Proposed 6500' SOH at a location on bare lava rock surface, some 1 1/2 mile downrift of the 1960 eruptive vent.

1. This hole would evaluate the geothermal potential on the interpreted axis of the KERZ.

2. The area presently has only marginal value as agricultural land. Easy access for an SOH location is indicated.

3. Plan to use the flow test option for evaluation.

SOH-G

Proposed 7500' SOH at location in northeast corner of the Kamaili GRS.

1. SOH G is intended to obtain more control on the Kilauea buttressed contact with the underlying Mauna Loa volcanics. It may assist with the Mauna Loa ERZ junction concept.

2. Meteoric water flows, within the Mauna Loa volcanics, may be favorably positioned in this locale to access the KERZ geothermal regime.

3. SOH G should provide information on deep drilling requirements should a KERZ north flank reservoir potential be indicated.

4. Detailed geophysical surveys and geochemical analyses will require hard borehole and flow test data to assist any creditable prediction of north flank reservoir potential. Data from SOH 3, D and G should provide an important hard data base for this purpose.

SOH H

Proposed 6500' hole to identify representative rock, thermal and hydrologic profiles with depth on the seaward side of the apparently sharp south boundary of the KERZ and the known productive reservoir.

1. Three unsuccessful geothermal wells, Ashida 1, Lanipuna 1 and 6, suggest the boundary is sharp, nearly vertical and planar. Young dike emplacement or mineral deposition from sea water intrusion are likely factors.

2. Geophysical interpretations and improved structural analysis for the south boundary should follow if the SOH H could obtain a "normal subsurface profile" just in front of the south boundary and its evident southward growth processes.

3. Proximity of SOH H to the known geothermal reservoir is specially appropriate for this hole and its mission.

4. The meteoric seawater transition in SOH H may be of primary interest; a specific geophysical borehole logging program should be considered in the 8 1/2" rotary drilled hole.

5. The location should be easily accessed from the hard top road and would be immediate to south edge of the Kapoho GRS.

CONCLUSIONS:

Each of the 8 SOH sites, recommended for consideration, address specific scientific issues or problems. As a group, the 8 SOHs should make a major, extensive contribution to the critical knowledge of resource extent, magnitude and character. All are within existing GRS where favorable results should offer early and strong inducement to full well exploration and production drilling by private operators. These SOH sites are believed to be consistent with all Program objectives, to promise a rewarding synergy in concert with private operator activity and to present a more defendable position with Hawaii County authorities in the required permit process.

cc: R. A. Patterson

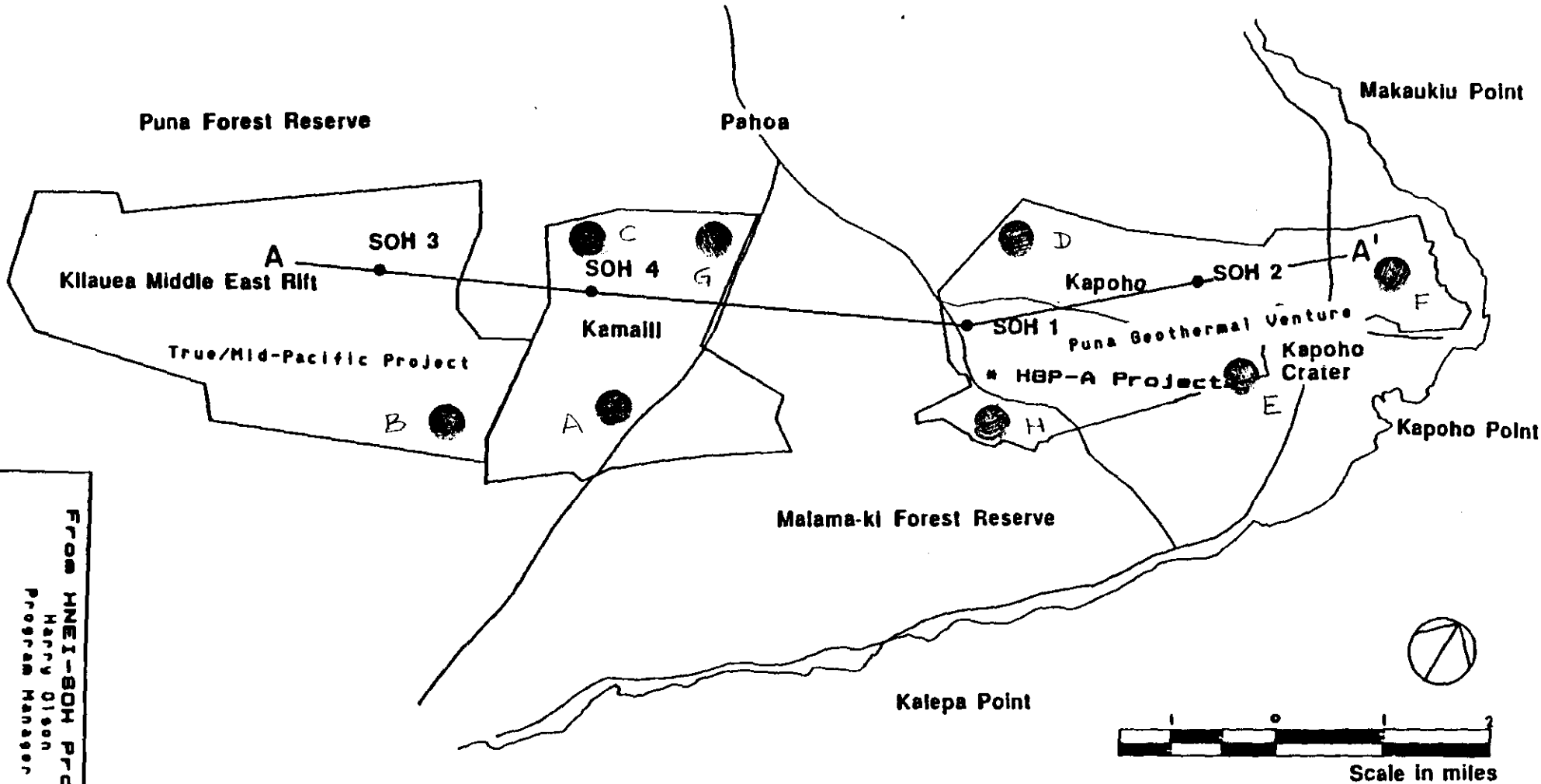


Figure 1 Location of SOHs on the Big Island

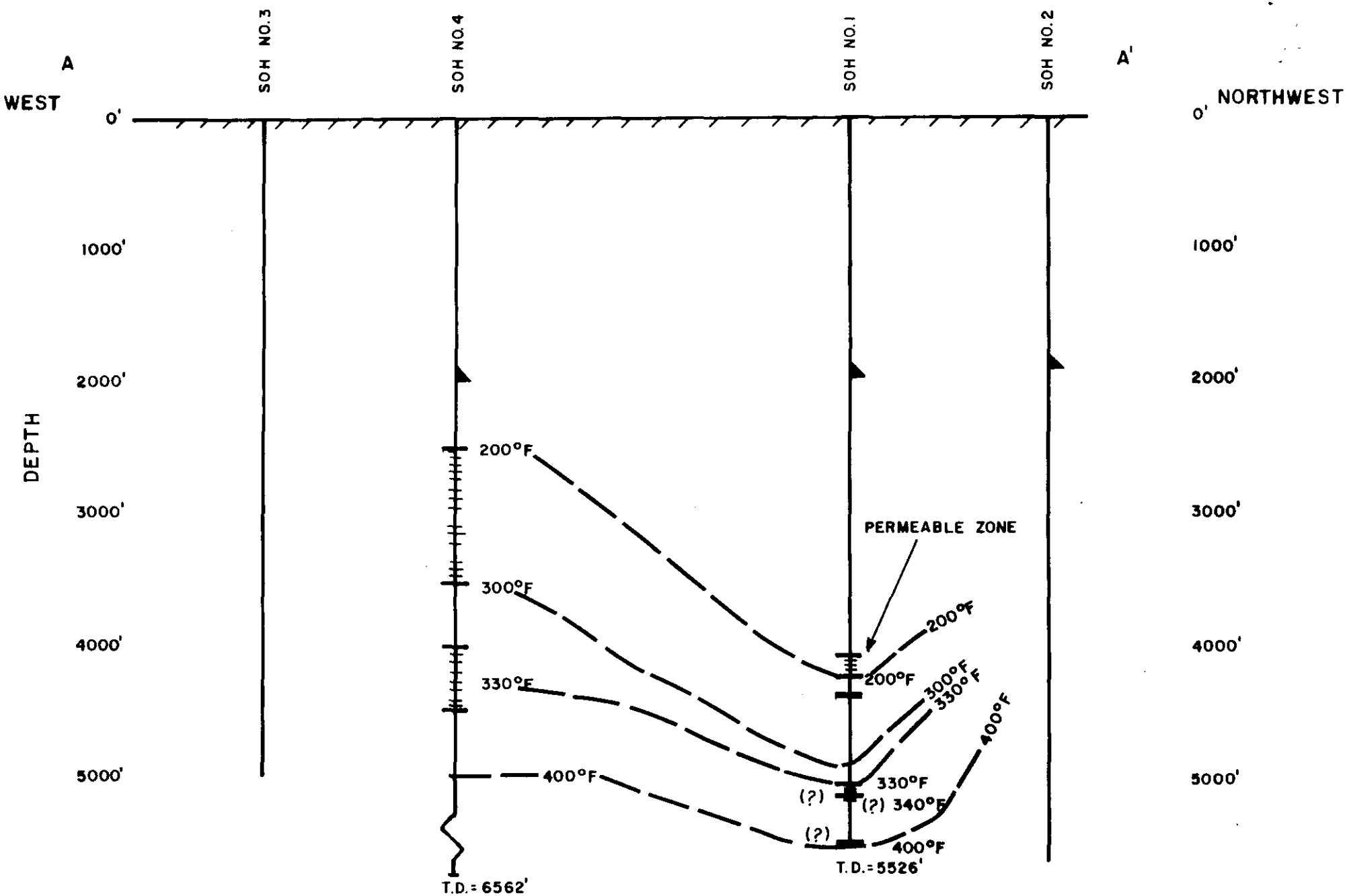


FIGURE 2: PERMEABLE ZONES AND ISOTHERMS
(CROSS SECTION A A' VS. DEPTH)

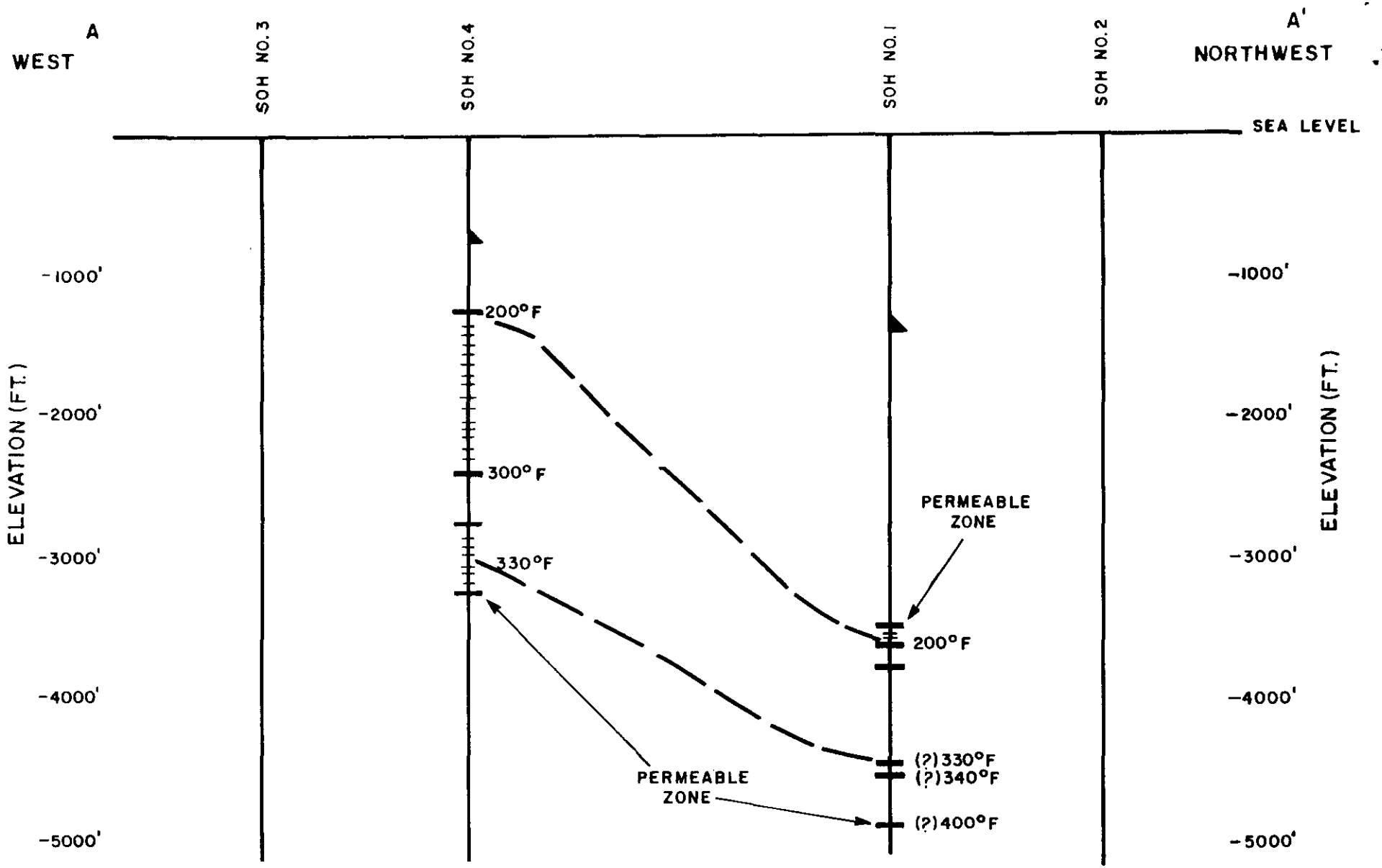


FIGURE 3: PERMEABLE ZONES AND ISOTHERMS
(CROSS SECTION A A' VS. ELEVATION)

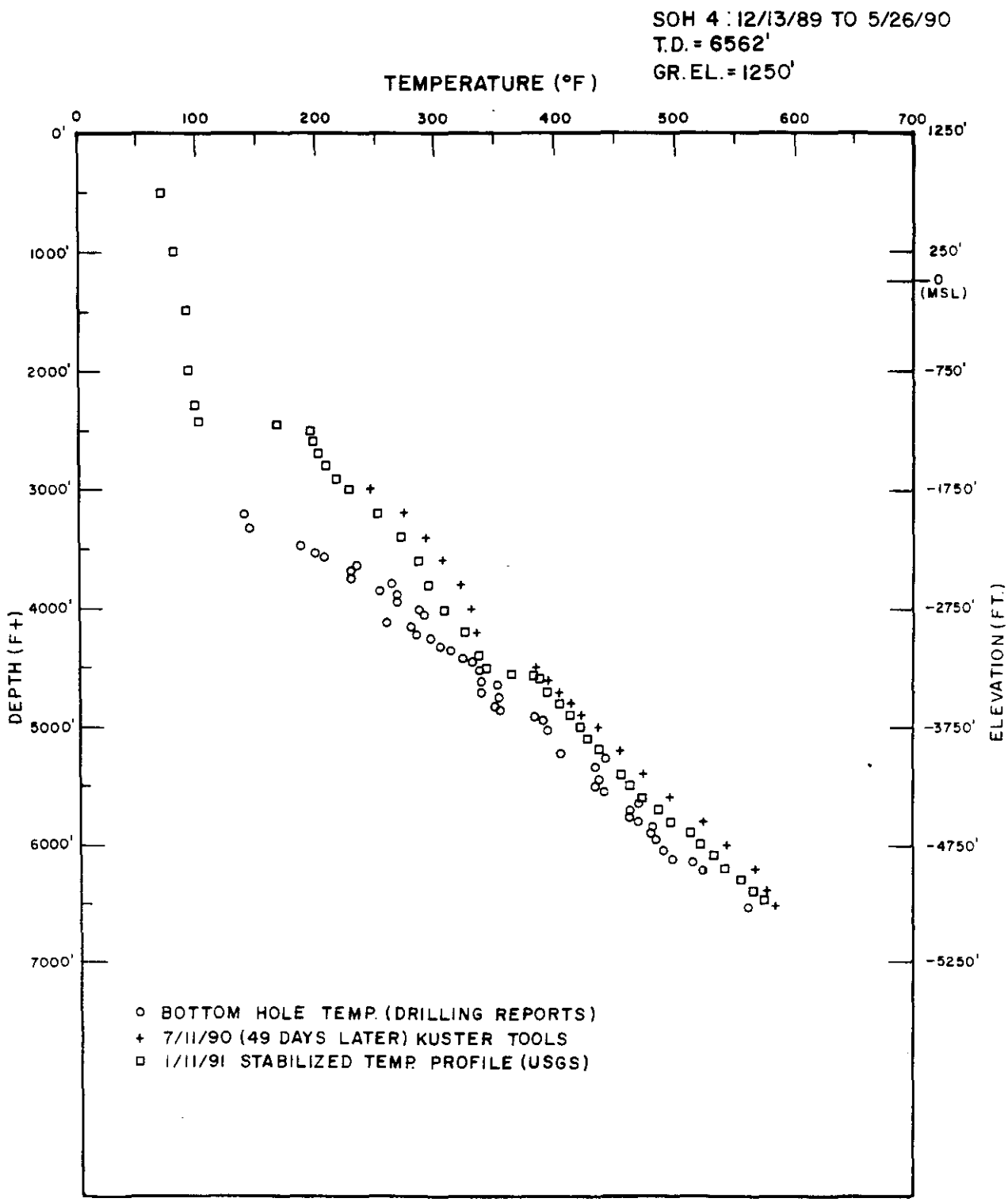


FIGURE 4 : TEMPERATURES VS DEPTH IN SOH 4